THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[Registered as a Newspaper.]

Vol. XXXIV. No. 844.] LONDON, JULY 15, 1879. [31st Year.] Price 6d.

GAS PURIFICATION
BY
OXIDE OF IRON.

COOKE BROS.,
CENTRAL DEPÔTS:
CO. DONEGAL, IRELAND;
LONDON DEPÔT:
BLACKWALL, E.;
OFFICES:
26, 27, & 28, FENCHURCH ST.,
LONDON, E.C.

GENUINE TORBAY
PAINT
Resists Sulphuretted Hydrogen. Does not Blister, Crack, or Flake off. Has very large surfacing powers.
THE TORBAY PAINT COMPANY,
(Proprietors) STEVENS & CO.,
21, Great Winchester St., London, E.C.
Works: BRIXHAM, DEVON.

THOMAS PROUD,
BROOKFIELD GAS APPARATUS WORKS,
103, ICKNIELD STREET EAST, BIRMINGHAM.
CONTRACTOR FOR
LAYING MAINS
FOR
Gas, Water, & Sanitary Purposes,
AND MANUFACTURER OF
WOOD GRIDS
FOR
SCRUBBERS AND PURIFIERS.

COWEN'S PATENT FIRE-CLAY RETORTS.
JOSEPH COWEN and CO.,
BLAYDON BURN, BLAYDON-ON-TYNE,
Were the only parties to whom a Prize Medal was awarded at the Great Exhibition of 1851, for "Gas-Retorts and other Objects in Fire-Clay," and they were also awarded at the International Exhibition of 1862, the Prize Medal for "Gas-Retorts, Fire-Bricks, &c., for Excellence of Quality."
J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shaped Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.
COWEN'S GARESFIELD COALS.
Jos. Cowen & Co. are the only Manufacturers of Fire-Bricks and Clay Retorts at Blaydon Burn.

JOHN RUSSELL & CO.,
LIMITED,
Established at the commencement of Gas Lighting,
Manufacturers of
TUBES AND FITTINGS.
THREE PRIZE MEDALS,
Paris, 1878.
Head London Office:
145, QUEEN VICTORIA STREET.
ALMA TUBE-WORKS, WALSALL;
OLD PATENT TUBE-WORKS, WEDNESBURY.

JOHN BENT & SON,
BELL BARN ROAD, BIRMINGHAM,
MANUFACTURERS OF
WET AND DRY GAS-METERS,
LICENSEES AND MANUFACTURERS OF
HUNT'S
PATENT COMPENSATING METERS,
STREET-LAMPS, &c., &c.
Established 1830.

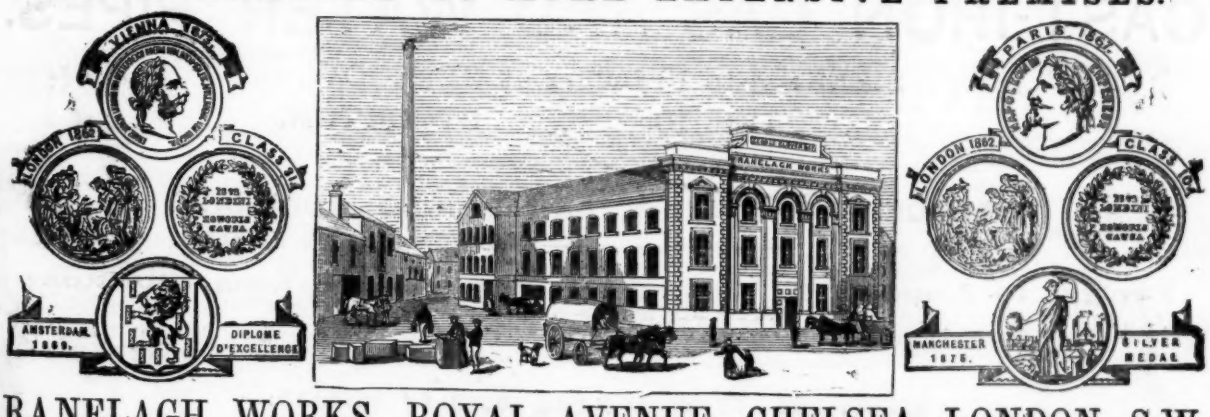
THOMAS PIGGOTT & CO.,
SPRING HILL, BIRMINGHAM,
MANUFACTURERS OF
TELESCOPIC & SINGLE GASHOLDERS,
CAST & WROUGHT IRON TANKS FOR DITTO,
And Gas Apparatus of every Description.
Marine, Tubular, Cornish, Plain, Furnace, Saddle, and Range Boilers.
Sugar, Saltpetre, and all kinds of Pans.
Roofs, Girders, and Bridges, and General Smith's Work.
London Offices: 97, CANNON STREET—
JAMES E. & SAMUEL SPENCER, Agents.

THE
"OTTO" GAS-ENGINE.
See Page 86.

CROSSLEY BROTHERS,
MANCHESTER AND LONDON.

THE
NITSHILL COMPANY'S
DUKE OF HAMILTON'S
LESMAHAGOW
CANNEL COAL.
AGENT:
JAMES M'KELVIE,
HAYMARKET,
EDINBURGH.

CHANGE OF ADDRESS.
GEORGE GLOVER AND CO.,
DRY GAS-METER MANUFACTURERS.
HAVE REMOVED TO MORE EXTENSIVE PREMISES:



RANELAGH WORKS, ROYAL AVENUE, CHELSEA, LONDON, S.W.

WELLINGTON TUBE WORKS,

GREAT BRIDGE, TIPTON, STAFFORDSHIRE.

JOSEPH AIRD,

GAS, STEAM, AND HYDRAULIC TUBES AND FITTINGS.

HONOURABLE MENTION, PARIS EXHIBITION, 1878.

J. E. WILLIAMS & CO.,

SOLE MANUFACTURERS OF THE

SPECIAL METALLIC OXIDE PAINT,

Largely used by Gas Companies, Corporations, Railway Companies, Ironfounders, and Machinists. It has the following qualifications and properties:—

EFFECTUALLY PREVENTS AND ARRESTS CORROSION.
HAS A FINE GLOSS, AND IS VERY DURABLE.
DOES NOT REQUIRE DRIERS LIKE OTHER PAINTS.
PROTECTS IRON FROM ACTION OF WATER.

IS NOT AFFECTED BY SULPHURETTED HYDROGEN.
FORMS A VERY HARD TOUGH (NOT BRITTLE) SURFACE.
WILL NOT CRACK, BLISTER, OR SCALE
IS NOT AFFECTED BY EXTREMES OF TEMPERATURE.

COVERS NEARLY DOUBLE THE AREA OF OTHER PAINTS.
(7 gallons or 1 cwt. will cover 1211 square yards of Ironwork.)
IS CHEAPER AND MORE ECONOMICAL THAN ANY OTHER.

VICTORIA PAINT WORKS, COLLYHURST, MANCHESTER.

FLETCHER AND MURPHY,

GARRATT STREET WORKS, OLDHAM ROAD, MANCHESTER;

Manufacturers of

IMPROVED CONSUMERS WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

AND

IMPROVED DRY GAS-METERS;

STATION-METERS OF ALL SIZES, with PLANED JOINTS;

GOVERNORS, PRESSURE AND EXHAUST REGISTERS, TEST HOLDERS.

And all kinds of Experimental Gas Apparatus.

THOMAS ALLAN & SONS,

IRONFOUNDERS.

WORKS:

SPRINGBANK FOUNDRY & NORTH WOODSIDE FOUNDRY,

GLASGOW;

BONLEA FOUNDRY, STOCKTON-ON-TEES,

Manufacturers of

CAST-IRON GAS AND WATER PIPES.

SIZES: ¾ to 12 inches at GLASGOW.
„ 1½ to 10 „ STOCKTON.

A LARGE STOCK KEPT, AND PRICES MODERATE.

Freight to London, in the Stream, 10s. per ton from Stockton; 15s. from Glasgow.

AGENTS FOR LONDON AND THE SOUTH OF ENGLAND:
THE THAMES BANK IRON COMPANY, UPPER GROUND STREET, LONDON, S.E.

HYDRATED PURIFYING MATERIAL.

Samples on application.

MESSRS. SPENCE BROS., LIMITED,

Will be glad to supply the above on the most favourable terms, and to treat, by Purchase or Exchange, for Spent Oxide.

PRICES ON APPLICATION.

ALSO PATENT DRY COPPERAS FOR EXTRACTING AMMONIA.

VICTORIA CHEMICAL WORKS, BRADFORD, NEAR MANCHESTER.

IMPROVED HYDRAULIC CRANES,

Effecting a great saving in the cost of discharging Coals from Vessels, Barges, &c. Several of these Cranes, with the necessary power, are now being erected at Beckton, Hull, and other Gas-Works.

HYDRAULIC APPARATUS for Lifting and Lowering Purifier-Covers.

Sixteen recently erected at Beckton, applied to Covers 30 feet square.

SULPHATE OF AMMONIA APPARATUS,

IN SUCCESSFUL OPERATION AT THE NEW WORKS OF THE NEWCASTLE AND GATESHEAD GAS COMPANY, AND IN COURSE OF ERECTION AT THE CARLISLE CORPORATION GAS-WORKS.

Special "REGULUS COCKS" manufactured to stand Acid.

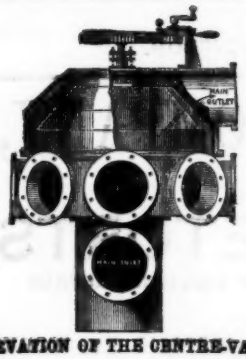
FOR PARTICULARS, APPLY TO

JOHN ABBOT & CO., LIMITED,

2, SUFFOLK LANE, CANNON STREET, E.C., or PARK WORKS, GATESHEAD-ON-TYNE.

C. & W. WALKERS'

PATENT CENTRE-VALVES.



ELEVATION OF THE CENTRE-VALVE.

PLAN OF THE VALVE.

PLAN OF THE BODY.

These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers on the system of three in action, and one out of action. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A considerable improvement and saving is effected in the cost of the connecting-pipes.

MIDLAND IRON-WORKS, DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.

WILLEY & COMPANY,

GAS ENGINEERS,

WORKS: COMMERCIAL ROAD, EXETER,

INVITE THE ATTENTION OF GAS COMPANIES AND OTHERS FOR THE SUPPLY OF

EVERY DESCRIPTION OF GAS APPARATUS.

ENGINEERING DEPARTMENT.

NEW GAS-WORKS erected complete. Plans and Estimates furnished. MAINS, METERS, SERVICES, LAMPS, &c., adapted for Towns of any size. Gas Companies advised on Improvements, Extensions, and Alterations of Works.

GASHOLDERS AND TANKS.

RETORTS and RETORT-HOUSE FITTINGS, CONDENSERS, SCRUBBERS, ENGINES and EXHAUSTERS, PURIFIERS, STATION-METERS, GOVERNORS, VALVES, &c.

METER DEPARTMENT.

They beg special attention to the excellence and superiority of their WET and DRY METERS, several thousand being now in use by many of the largest Gas Companies in the West of England and South Wales. Warranted to measure correctly, and not to vary. Their acknowledged superiority has brought them into general use more rapidly than any Meters hitherto manufactured. A guarantee of Five years tendered with each Meter.

GAS-FITTING DEPARTMENT.

An extensive variety of Choice Designs in CHANDELIERS, PENDANTS, BRACKETS, STAR and SUN LIGHTS, MEDIÆVAL FITTINGS for CHURCHES, &c.

PATTERN-BOOKS and PRICE LISTS furnished.

☞ PLEASE NOTE THE ADDRESS—

GAS ENGINEERING WORKS, COMMERCIAL ROAD, EXETER.

GAS PURIFICATION

BY

OXIDE OF IRON.

GAS PURIFICATION & CHEMICAL Co., LIMITED,

PALMERSTON BUILDINGS, OLD BROAD STREET, LONDON, E.C.

JOHN WM. O'NEILL, Managing Director.

MESSRS. NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD,

MANUFACTURERS OF

IMPROVED CENTRE-VALVES,

PURIFIERS, CONDENSERS, SCRUBBERS, GASHOLDERS, ROOFS,

And every description of Gas Machinery.

TENDERS GIVEN FOR WORK FIXED COMPLETE IN ANY PART OF THE KINGDOM.

WEST'S GAS IMPROVEMENT COMPANY,

LIMITED,

ARE NOW PREPARED TO SUPPLY AND ERECT THEIR PATENTED MACHINERY FOR

CHARGING AND DRAWING GAS-RETORTS,

And to enter into arrangements with GAS COMPANIES for its use upon moderate terms of Royalty.

The Patented Machinery has secured the approbation of all Engineers who have visited the MAIDSTONE GAS-WORKS, *where it is in full operation, and may be inspected at any time on application to the Manager.*

The advantages attending its use are—

INCREASED VOLUME OF GAS PER TON.—INCREASED YIELD PER RETORT.—INCREASED BULK OF COKE FOR SALE.—REDUCTION IN LABOUR AND LESS DEPENDENCE ON SKILLED STOKERS.

A Pamphlet containing a description of the Machinery, and Copies of Reports on the working of the same, &c., will be forwarded on application to the MANAGING DIRECTOR, Maidstone. Communications may also be addressed to the Consulting Engineer, R. P. SPICE, Esq., M. Inst. C.E., 21, Parliament Street, London, S.W., or to the Engineer and Analyst, F. W. HARTLEY, Esq., A. Inst. C.E., 55, Millbank Street, London, S.W.

EDWARD COCKEY & SONS,

GAS ENGINEERS, FROME SELWOOD,

MANUFACTURERS OF ALL DESCRIPTIONS OF

APPARATUS CONNECTED WITH GAS-WORKS.

THE ORIGINAL PATENTEES AND MANUFACTURERS OF THE

DRY-FACED VALVES

FOR PURIFIERS, GASHOLDERS, BYE-PASS, AND OTHER ARRANGEMENTS REQUIRING VALVES IN GAS-WORKS.

The Faced Valves, as made by the Patentees, continue to give great satisfaction, and they are being used extensively by many of the best gas engineers of the day.

They are more easily repaired than any other kind of Valve in use, and can be re-ground in a few hours without removal, and made perfectly gas-tight.

References can be given to many Engineers of high standing, who will testify as to the favour in which they are held.

MANUFACTURERS ALSO OF SUPERIOR WOOD GRIDS FOR PURIFIERS, SCRUBBERS, &c.

GEORGE ORME & CO.,

ATLAS METER-WORKS, OLDHAM,

MANUFACTURERS OF

WET AND DRY GAS-METERS,

STATION-METERS, GOVERNORS,

PRESSURE AND EXHAUST REGISTERS,

LAMP-METERS IN CAST-IRON BOXES,

And every Description of Gas Apparatus.

JAMES MILNE & SON,

GAS ENGINEERS,

Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,

EDINBURGH, AND

2, KING EDWARD STREET,

NEWGATE STREET, LONDON.

Meter Works in London—2, CROSS STREET, WILDERNESS ROW, E.C.

STATION-METERS GOVERNORS, CONSUMERS METERS, GAS LUSTRES, CHANDELIERS, BRACKETS, &c.,

And every description of Gas-Fittings and Gas Apparatus.

J. & J. BRADDOCK,

GLOBE METER-WORKS, OLDHAM,

MANUFACTURERS OF

WET & DRY CONSUMERS GAS-METERS,

OF THE HIGHEST EXCELLENCE ONLY;

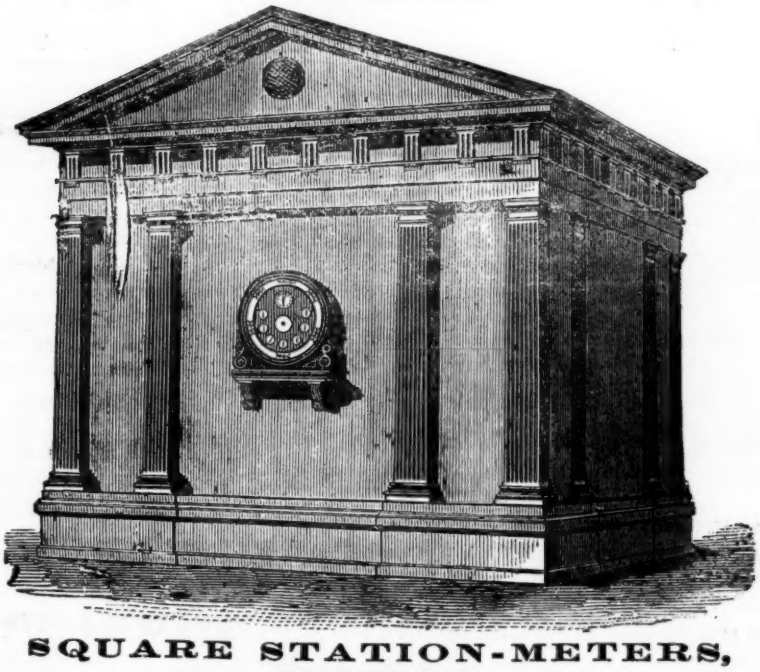
BRADDOCK'S PATENT COMPENSATING GAS-GOVERNORS;

ALSO LICENSEES AND MANUFACTURERS OF

WARNER & COWAN'S PATENT SELF-REGULATING GAS-METERS;

ROUND STATION-METERS,

ON CAST-IRON STANDS.



SQUARE STATION-METERS,

WITH PLANED JOINTS.

GOVERNORS, GAUGES, INDICATORS, MAIN COCKS, &c.

GAS COOKING APPARATUS.

Home and Foreign Orders promptly attended to.

All Sizes of CONSUMERS METERS, STATION-METERS, and GOVERNORS generally in Stock.

Orders almost invariably despatched on the day of receipt.

TERMS, &c., ON APPLICATION.

C. & W. WALKER'S

WOOD PURIFIER SIEVES,

Which have now been used for fifteen years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.

MIDLAND IRON-WORKS,
DONNINGTON, NEAR NEWPORT, SHROPSHIRE.
FINSBURY CIRCUS, LONDON.

ESTABLISHED IN 1860.

BENJAMIN CARPENTER,

THE ORIGINAL MANUFACTURER OF THE IMPROVED

WOOD SIEVES

FOR

GAS PURIFIERS & SCRUBBERS.

PROVIDENCE WORKS,
22, HERMES STREET, PENTONVILLE ROAD,
LONDON, N.

The Dunston Engine Works Co.,

GATESHEAD-UPON-TYNE.

Are the Sole Manufacturers of

Archer's Patent Hoists,

ALSO OF

Archer's Patent Stone Breaker,

AND OF

Archer's Patent Ore Crusher & Pulveriser,

The last-named Machine (without the Pulveriser) makes the best and most durable Coke Breaker.

GRIRDROD'S PATENT

PORTABLE PIPE SCREWING

MACHINE,

For 1 in., 1¼ in., 1½ in., and 2 in. Gas Threads, complete £7 10s.

In use at the chief gas-works, and giving great satisfaction.

For other useful goods, see Bailey's "Illustrated Inventions," post free 3s. 6d.; gratis to ledger customers.

W. H. BAILEY & CO.,

Brassfounders, Gauge Injector and Tool Makers,

ALBION WORKS, SALFORD,

LANCASHIRE.

Gold Medal Awarded, Paris Exhibition, 1878.

THOMAS TURTON AND SONS,

SHEAF AND SPRING WORKS,

SHEFFIELD,

MANUFACTURERS OF

FILES OF BEST QUALITY

FOR ENGINEERS,

STEEL OF ALL DESCRIPTIONS,

SCREW STOCKS, TAPS, AND DIES, SPANNERS, RATCHET BRACES, LIFTING-JACKS, ANVILS, VICES,

AND ENGINEERS TOOLS GENERALLY.

LONDON OFFICE:

90, CANNON STREET, E.C.

LAMBERT BROTHERS, WALSALL.

ALPHA TUBE & FITTING WORKS

Manufacturers of W. J. WARNER'S PATENT MARKET GAS STAND-PIPE.

Now ready, GAS CHANDELIER BOOK (Reduced Prices), 7s. 6d.

ROBT. DEMPSTER & SONS,

GAS ENGINEERS, IRONFOUNDERS, AND CONTRACTORS,

ROSE MOUNT IRON-WORKS, ELLAND, YORKSHIRE.

MANUFACTURERS OF EVERY DESCRIPTION OF

GAS APPARATUS;

CONTRACTORS FOR THE

ERECTION OF PUBLIC AND PRIVATE GAS-WORKS.

Plans and Specifications Prepared, and Illustrated Catalogues forwarded on application.

LIVESEY'S PATENT WASHER.

This apparatus effects the most intimate contact between the liquor with which it is supplied and the gas passing through it, resulting in the complete removal of all particles of tar, increasing the ammonia strength of the scrubber and condenser liquor, and removing a large proportion of other impurities—notably, carbonic acid. The Washer is intended to work in conjunction with a scrubber. It occupies little space, and is inexpensive. It has been in successful constant use for nearly three years, does not become clogged with tar or corroded by the action of the liquor or gases, it gives three inches of pressure, and only needs a supply of liquor to keep it in regular action without any further attention.

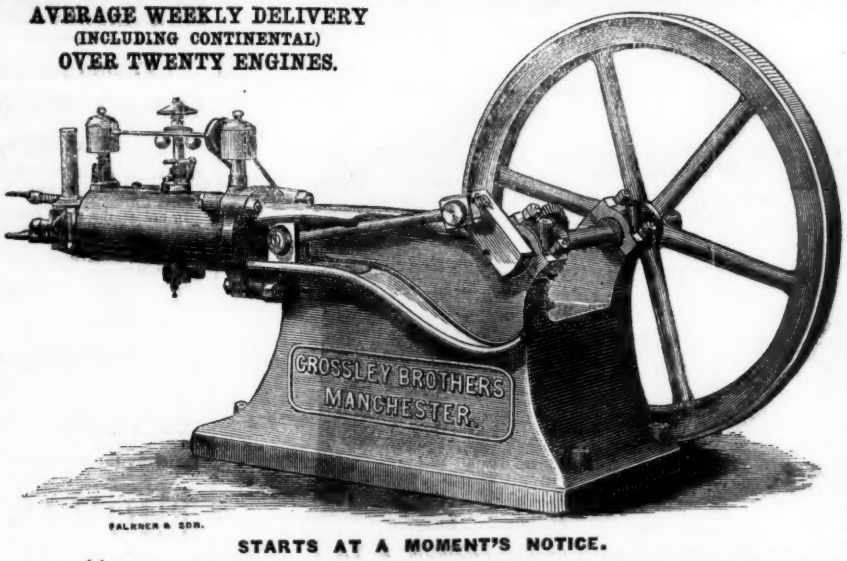
For Particulars and Prices apply to

Messrs. DEMPSTER AND SONS, ELLAND, HALIFAX, for the North;
Messrs. BAILEY, PEGG, AND CO., Bankside, LONDON, S.E., for the South;
Messrs. WILLEY AND CO., Commercial Road, EXETER, for West of England and South Wales
Or to the PATENTEE, 589, OLD KENT ROAD, LONDON, S.E.

AN ENGINE WHICH WORKS WITHOUT A BOILER OR STEAM

AVERAGE WEEKLY DELIVERY
(INCLUDING CONTINENTAL)
OVER TWENTY ENGINES.

The durability of these Engines is now established by experience, one of them having run night and day at the Hinckley Gas-Works for over Twelve months without any expenditure for repair; this being equal to about 2½ years average work.



Over 1900 already delivered.

Very numerous Testimonials from Users, including Engineers, Men of Science, and others, on application to the makers.

No trouble with Coal, Ashes, Smoke, Insurance, Water, or constant attendance.

No Glands to pack, or Water Gauges and Steam Gauges to watch.

STARTS AT A MOMENT'S NOTICE.

THE "OTTO" SILENT GAS-ENGINE.

(Otto and Crossley's Patents, 1876 and 1877,)

THEY ARE USED FOR ALL KINDS OF PURPOSES, CHIEFLY FOR EXHAUSTERS, SCRUBBERS, & PUMPS.

DELIVERED IN MANCHESTER.	SIZES									OFFERED.	CASES NOT CHARGED IF RETURNED FREE
	NOMINAL HORSE POWER	½	1	2	3½	6	8	12	16		
	MAXIMUM HORSE POWER	¾	1½	2½	4	9	12	18	24		

PRICES INCLUDE CAST-IRON STAND, TURNED FLY-WHEEL, AND DRIVING PULLEY; WATER-VESSEL, SEVERAL DUPLICATES, AND GAS-FITTINGS (EXCEPTING METER AND PIPES).

WORKS AND HEAD OFFICES:
Gt. Marlbro' St., Gloster St.

CROSSLEY BROTHERS,

MANCHESTER.

LONDON HOUSE:
116, Queen Victoria St., E.C.

TANGYE BROTHERS AND HOLMAN,

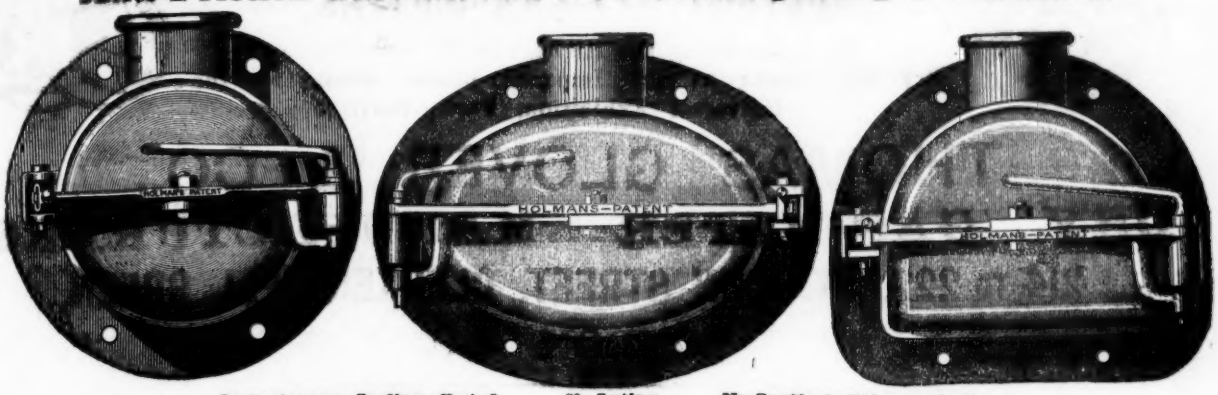
CORNWALL HOUSE, 35, QUEEN VICTORIA STREET, LONDON, E.C.,

(LATE OF 10, LAURENCE POUNTNEY LANE.)

SOLE MAKERS OF MORTON'S PATENT SELF-SEALING RETORT-LIDS,

WITH HOLMAN'S PATENT ECCENTRIC FASTENINGS,

Anti-Friction Catches, and New Self-Adjusting Cross-Bars.



Instantaneous Sealing effected. No Luting. No Duplicate Lids required.

Holman's New Self-Sustaining Cross-Bar ensures freedom of Joint, and maintains parallel position of the Lids.

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly tested, being now in use in nearly all the principal Gas-Works in London and the Provinces.

T. B. and H. are now making the "Morton's Self-Sealing Lid" of the SAME FORM OR SECTION AS THE RETORT (see Illustrations above), as well as bringing the Mouthpiece from the D or Oval at back to Circular in front, as heretofore.

D and Oval Morton's Lids are working satisfactorily both in this country, on the Continent, and in the United States of America. Among others they have been adopted by the following Gas-Works:—

The Gaslight Company's Works, Fulham; Ditto, Bromley-by-Bow; Ditto, King's Cross; Ditto, Shoreditch.
And also in the Gas-Works at Richmond, Maidstone, Gloucester, Glasgow, Portsea, Roubaix (France), The Hague (Holland

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption,

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at an convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.

These Governors have been adopted by many leading Gas Companies, among whom are the following:—

The Gaslight and Coke Co. (9), The London Gas Co. (3), and at Abergavenny, Arundel, Birmingham, Cannes (France), Devonport, Dursley, Exeter, Guernsey, Halesowen, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, Windsor, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1878.

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—The two 24-inch and three 36-inch Hunt's Equilibrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

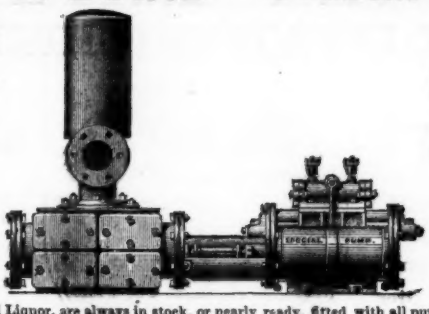
Yours truly,

(Signed) JOHN JOHNSON.

PRICES AND FULL PARTICULARS ON APPLICATION.

THE "SPECIAL" STEAM-PUMP.

Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons of Water per Hour, Approximate.	Reduced Prices.
3	1½	9	450	£16
4	2	9	815	18
5*	2½	12	1,250*	21
5*	3	12	1,830*	22 10
4	4	12	3,250	25
6*	4	12	3,250*	30
5	5	12	5,070	32 10
7*	5	12	5,070*	40
6	6	12	7,330	40
8*	6	12	7,330*	50
7	7	12	9,750	50
10*	7	12	9,750*	65



In use in a Hundred Gas-Works in the United Kingdom for Pumping Ammoniacal Liquor, Water, or Tar.

Messrs. Burt, Boulton, and Haywood, Manufacturing Chemists, have over FORTY "Special" Steam-Pumps in use at their several large Tar-Works.

Two Hundred Sizes made. Those in Table opposite are the leading Sizes for use in Gas-Works and Chemical Works.

* These Sizes being usually selected for pumping Tar and Liquor, are always in stock, or nearly ready, fitted with all pump details in iron, and extra length distance-piece between steam and pump cylinder, at a small extra cost.

TANGYE'S HIGH-PRESSURE AND CONDENSING STEAM-ENGINES; CORNISH, VERTICAL, & TUBULAR BOILERS; HYDRAULIC AND SCREW LIFTING-JACKS, CRABS, PULLEY-BLOCKS, &c.

FULL PARTICULARS, ESTIMATES, CATALOGUES, ETC., ON APPLICATION.

London, 1851. New York. 1853. Paris, 1855. London. 1862.

Dublin, 1865.

The SIX MEDALS AWARDED to THOMAS GLOVER for

PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters bv the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

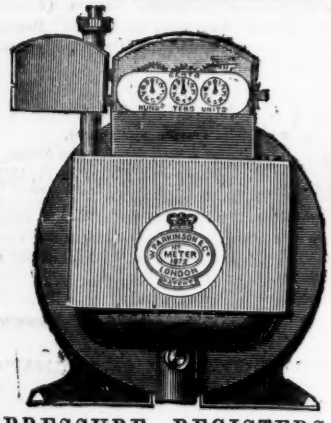
214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

LONDON, E.C.

THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS.

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON AND CO.,



(ESTABLISHED 1816,)

MANUFACTURERS OF

WET & DRY METERS,

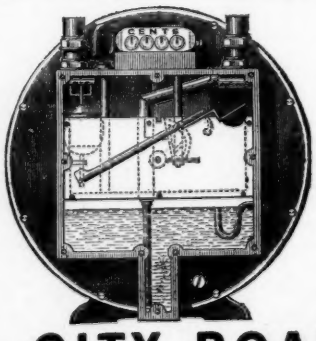
STATION-METERS & GOVERNORS,

EXHAUSTER REGULATORS,

PRESSURE REGISTERS, EXPERIMENTAL APPARATUS, GAUGES, WATER-METERS, &c.

HUNT'S PATENT IMPROVED COMPENSATING METER.

In this Meter, the action of the measuring-drum is reversed. By this arrangement an improvement is effected in the registration at high speeds, which, in many tests, has not varied from the smallest light to three times the capacity of the meter. It works equally well under all pressures. The range of error between the high and low line is much smaller than that allowed by the "Sale of Gas Act."



The Meter has been critically tested, and most favourably reported upon by official Meter Inspectors in London and Birmingham.

W. PARKINSON and CO. have made arrangements for the manufacture of these Meters, both in tin and cast-iron cases, and for the alteration of old ones to this principle, which is confidently recommended as possessing every quality that can be desired by Gas Companies, Corporations, or Private Consumers.

COTTAGE LANE, CITY ROAD, LONDON, E.C.

CONTENTS.

	Page
Circular to Gas Companies:—	
The Bill of the Alliance and Dublin Gas Company	89
The Liverpool Lighting Bill	89
The Destruction of a Gasholder at Dartford	89
Public Lighting at Hanley	89
Reduction in the Price of Gas by the Commercial Company	89
British Association of Gas Managers—	
Mr. Ross on "The Application of Hydraulic Machinery to Gas-Works"	90
Mr. Price on "A Tell-Tale Arrangement for Lamp-Lighters"	90
Professor Foster on "The Estimation of the Strength of Ammoniacal Liquor"	90
The Meeting of the North British Association of Gas Managers—Inaugural Address of Mr. Alex. Smith	90
Annual Meeting of the Société Technique de l'Industrie du Gaz en France	90
Mr. Field's Analysis of the Accounts of the Metropolitan Gas Companies for 1878	90
Mr. Paterson's "Notes on the Lithology of Gas Coals," &c.	90
Water and Sanitary Notes:—	
The Indemnity Bill of the Metropolitan Board of Works	90
The Water Supply of Liverpool	91
A Sewerage Scheme for Rochdale	91
The Water Supply of Wakefield	91
The Water Supply of Halifax	91
The Annual Meeting of the Sanitary Institute of Great Britain	91
Correspondence:—	
The Gas and Water Companies Association and the Applications for Electric Lighting Powers	92
Parliamentary Intelligence:—	
Progress of Bills in House of Lords	92
Progress of Bills in House of Commons	92
Metropolitan Board of Works (Water Expenses) Bill	92
Alliance and Dublin Consumers Gas Bill	92
House of Commons Committee—Liverpool Lighting Bill	92
Legal Intelligence:—	
South Shields County Court—South Shields Corporation v. South Shields Gas Company	97
Miscellaneous News:—	
Glasgow Gas and Water Supply	91
Sewage Scheme for Llandaff	97
British Association of Gas Managers	98
Saltcoats Gas Company	102
North British Association of Gas Managers	103
Société Technique de l'Industrie du Gaz en France	104
The Annual Dinner of Inspectors of the Chartered Gas Company	104
The Proposed Substitute for Candles in Testings for Illuminating Power	105
The Water Supply of Halifax	106
The Water Supply of Wakefield	106
Counter-Sunk Seal Gas-Meter Unions	107
Trade Reports	107
Reduction in the Price of Gas in the Metropolis	108
Halesworth Gas Company	108
New Water-Works for Blackrod	108
Quality of the Wigan Gas	108
Institution of Civil Engineers	108
Chicago Water-Works	108
Hindley Local Board Gas Supply	108
Sanitary Institute of Great Britain	108
Register of New Patents:—	
Applications for Letters Patent	108
Patents which have passed the Great Seal	108
Patents which have become void	108

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 15, 1879.

Circular to Gas Companies.

The Alliance and Dublin Gas Bill has passed a Committee of the House of Lords, but the influence of Sir Arthur Guinness has so far prevailed with Earl Redesdale that all clauses in the Bill which would directly or indirectly give the Company power to supply the electric light have been struck out, or amended so as to prevent the Company from having any authority in respect to it. Of course, it was never intended that the Company should have any exclusive power to furnish the electric light. It was settled long ago that no such exclusive privilege could be granted; but the Company were fairly entitled to make experiments with the light, as it promised to lend itself to their service. There are questions behind, which would, of course, require consideration. For example, how far could the Company apply capital, granted for the purpose of supplying gas, to making experiments with the electric light? The answer of their opponents would, of course, be a very ready one: No such power can be conferred. As for a monopoly to supply the new light, no one dreams of such a thing. The Company might demonstrate the feasibility of illuminating public spaces and large interiors, but nothing in the shape of a monopoly could be granted. We may take the Bill as it is now amended, and as it will pass, with the remark, that it will be long before Dublin rejoices in the exhibition of an electric light. The impecunious Corporation could do nothing, if they had the will to do anything. Adventuring inventors may come from all quarters to exhibit their lights; but if they are successful, who is now to take them up and make them render public service? The Corporation never will, and now the Gas Company are prohibited. Who, then, will introduce the electric light to Dublin? We look on the fate of this Bill as in every way unfortunate. It was promoted with the best possible intentions, and if it had been carried in the form in which the Company proposed, it would have given them the opportunity of employing the light or not as it seemed convenient to them. As it is, it is left to the Corporation or a new Company to promote a Bill when the electric light has been so developed that its exploitation promises to be interesting to the public and advantageous to investors. We know very well that the Corporation will never do anything, and as for a new Company, the chances of raising capital for any public purpose in Dublin are very remote indeed.

In other columns we publish a report of the proceedings on the Liverpool Lighting Bill before a Select Committee of the House of Commons. The evidence was of a very interesting character, and fully bore out our opinion that the object of the Liverpool Corporation was to gain a foothold for the supply of light for public and private purposes. In thie attempt, however, they have been disappointed; but sufficient power has so far been given as will enable them to make a series of experiments to ascertain whether or not the electric light may be made permanently available. The Bill, as we said last week, will be opposed in the House of Lords, with what result we know not. It is curious to note that the Corporation do not show their hands, or give us any idea of what they intend to do if they should gain the power which is so far accorded. What system of lighting do they propose to adopt? Is it the Jablochkoff, the Lontin, the Rapieff, or the Werdermann? or do they intend to rely upon Mr. Edison's inventions, of which so much is now being written? It seems probable that as long a time will be taken in considering the light to be adopted, as has been consumed in arriving at a decision as to the source of a new water supply. In this case, the five years which the Committee have granted to the Corporation will be occupied in perfectly useless discussions, without a single electric light being displayed. Corporations move very slowly, and, considering the vagueness of the propositions for electric lighting now before the public, we shall not be surprised to see the five years pass without any decision from the Council as to the best light to be adopted. But our speculations are at present premature; we must wait the result of the deliberations of the Lords Committee before we express any further opinion.

The cause of the explosion at the Dartford Gas-Works, to which we referred in our last issue, is now made tolerably clear. The cast-iron tank, standing about 16 feet out of the ground, gave way under the pressure of the water, which ran in torrents all over the works, and, as a matter of course, the seal being removed from the holder, the gas escaped. There can be little doubt the first explosion occurred in the open, but as the gas escaped from the holder, air, of course, got in, and thus there resulted an explosion within the holder. It is quite clear that nothing but a veritable explosion, caused by the ignition of mixed air and gas, could have wrought so much destruction, and how the air got into the holder is now perfectly explained. The moral of the accident, so far as we can see, is that managers should look after the strength of their cast-iron tanks.

A majority of the Town Council of Hanley are waking up to the fact that a gas-lamp is nearly equal to a policeman for the preservation of social order. The roughs in the town of "man-and-dog fight" celebrity are addicted to committing assaults on the police and innocent passers-by during the dark hours. Hitherto the Town Council have not lighted the lamps in the borough during the months of June and July, and it would appear that it is just in the dark hours of these months that most burglaries and assaults take place. It is an old remark with us that gas has contributed more than any other agency to the safety of our streets, and we feel certain that the Town Council of Hanley will never regret the small expense they will incur by lighting the streets during the dark hours of the summer nights—this year exceptionally dark.

The Directors of the Commercial Gas Company have given notice that from and after Midsummer-day last the price of gas will be reduced from 3s. 5d. to 3s. 3d. per thousand feet. The standard price of the Company, subject to the sliding scale, is 3s. 9d. per thousand; thus they might, during the past half year, with a charge of 3s. 5d. per thousand feet, have paid a dividend of eleven per cent. As a matter of fact, however, they have only paid ten and a half per cent. Now that the price is reduced by another twopence, they will be enabled to pay eleven and a half per cent. Supposing all things to go well, we may expect that the first dividend declared by the Company next year will be eleven per cent., which will make them the best paying Company in the Metropolis.

The paper read at the recent meeting of the British Association of Gas Managers, by Mr. J. A. G. Ross, of Newcastle-on-Tyne, "On the Application of Hydraulic Machinery to "Gas-Works," possessed a good deal of interest, and we expect the Managers went home full of ideas as to the future use of the principle. There is, no doubt, a great future for the use of hydraulic power in gas-works, but up to this time the applications of the principle have not been numerous. For lifting, it possesses the merit of cheapness, and we may say of facility for use. Mr. Ross, indeed, proposes to perform all the mechanical operations in gas-works by means of hydraulic power, it being more easily managed, more reliable, less costly, and requiring the least attention of any other mode of generating and applying power. Mr. Colyer's objection, that steam power may be cheaper in small works, may be answered by the recommendation of Mr. Ross to use a gas-engine as the prime mover, in which case, doubtless, economy must result. The installation of hydraulic machinery may be found to be rather expensive in the first instance, but in the end we believe it will prove economical.

Mr. Price, of Hampton Wick, has invented an ingenious tell-tale arrangement for ascertaining the time at which lamplighters complete their rounds, either for lighting or extinguishing the lamps, which will commend itself to the notice of managers who are plagued by the negligence of their *employés*. Of course, a great loss results to the Gas Company if the lamps are not extinguished at the contract hours. It is to prevent this loss from the negligence and idleness of the men that Mr. Price has invented his tell-tale arrangement, which we commend to all managers who are troubled as Mr. Price has been.

Professor Foster's method of estimating the strength of ammoniacal liquor by determining the amount of nitrogen evolved when the liquor is treated with a strongly caustic solution of hypobromite of soda, is very ingenious, and no doubt very accurate; still, we have a doubt whether it will commend itself to the attention of gas managers. Simple and rapid as the execution of an experiment appears to be, it is not, we think, likely to supersede the distillation process, which gives equally accurate results with a little more trouble and infinitely less calculation. Besides, the process may be considered expensive, for bromine is dear—sometimes very dear—and, moreover, not an agreeable thing to handle. Nevertheless, we welcome this, as we do all other new processes which promise improved results.

The North British Association of Gas Managers had a very successful meeting at Edinburgh last week. The attendance of members was large, and, as we mentioned in our issue of July 1, the business to be transacted was of a very interesting and important character. We are happy to say that all the papers were read, and most of them fully discussed. We give to-day the Inaugural Address of the President, Mr. Alexander Smith, of Aberdeen, and it deals with one or two points of interest. There are, as all our readers know, two Associations of Gas Managers in Scotland—the West of Scotland and the North British. It is now proposed to amalgamate these two Associations, by which it is believed their usefulness would be much increased. We must ask pardon for expressing a doubt upon this point. As they now stand, each contrives to get through its business within the allotted time. Now it is clear that if the two Associations were combined, and the communications of the two were brought to one meeting, either the time allowed for the reading of papers must be extended, or many would be left unread. The British Association, with the two days they allow for business, rarely, if ever, get through the communications presented. Three days would hardly suffice for the combined Scottish Association. If managers can spare the time, by all means let the union be effected. The other point of interest to which the President alluded was the formation of a Committee, as suggested by Mr. Hislop last year, to investigate and report on reputed inventions. A Committee of this kind might do very useful work, but to fairly carry out its objects would require more time and labour than most managers can spare from their daily avocations. We hope, however, that the suggestion will be followed up, for it may be made an instrument of much use to the gas community, by saving them from all sorts of quackery. For the rest, we may thank the President for his able and practical Address, which was a worthy opening to a highly successful meeting.

The sixth annual meeting of the Société Technique de l'Industrie du Gaz en France took place at Lille on the 16th and 17th ult., and necessarily proved a great success. The papers read were of a varied character, and some attracted considerable attention. It is worthy of mention that the members were hospitably entertained by the Imperial Continental Gas Association, whose important works at Lille they naturally visited. It is also worthy of note that the *entente cordiale* between the Society and the British Association of Gas Managers was renewed by the visit of a considerable number of the members to London, where, under the guidance of Mr. W. H. Bennett, they had the opportunity of visiting some of the best appointed works in the Metropolis. They were entertained by Mr. Corbet Woodall, of the Phœnix Gas-Works, Vauxhall, and evidently greatly enjoyed their trip. From a *réunion* such as this many advantages are to be derived. Intercourse at home is the first object of all Associations; but the gas manager cannot spread his arms too widely in gathering all the information that comes within his reach.

Mr. Field's annual abstract of the accounts of the Metropolitan Gas Companies has just been issued. It possesses its usual authoritative character, and will be accepted as a fair statement of the affairs of the Companies.

We may also mention here that Mr. James Paterson, C.E., F.G.S., &c., of Warrington, has republished in pamphlet form the "Notes on the Lithology of Gas Coals"* which he read before the meeting of the British Association of Gas Managers in 1872. This paper, with the appended analyses, is of great value, and managers cannot do better than refresh their memories by a reperusal.

Water and Sanitary Notes.

The Indemnity Bill of the Metropolitan Board of Works has been read a second time, and now stands for Committee of the whole House, in which it is proposed to make several amendments. A notice has also been given of a motion to postpone the Committee for three months. Now, however, that the Government have, to a certain extent, taken up the measure, we presume it will go on, and eventually pass, with, at all events, the amendments proposed by the Chancellor of the Exchequer, whose object is, first, to amend the preamble by striking out the introduction, which alleges that all the proceedings of the Board in regard to this matter were done wholly and solely to promote the comfort and health of the inhabitants of the Metropolis. Mr. Monk, who seems to take a great deal of interest in the Metropolitan water question, proposes that the words should be left in, and the following words inserted—"in excess of the powers "conferred upon them by Parliament." The Chancellor of the Exchequer further proposes to amend the preamble by leaving out the words which expressed the Board's belief that "they "were making application to Parliament for further powers "required for the public benefit of the inhabitants of the "Metropolis," and inserting in their place the bare expression that they believed they were "acting within their legal "powers." It is hardly correct to say so much, for the Board were repeatedly warned that they were exceeding their powers in promoting these Bills and incurring large preliminary expenses. They persevered, however, and the result is now before us. As regards the provisions of the Bill, Mr. Monk wishes it to be clearly expressed in clause 1 that this is an "Indemnity Bill," which means, we presume, that its operation is to be entirely restricted to the relieving of the Board from the cost of the proceedings of last year. As regards clause 2, Mr. Monk proposes that it shall run as follows:—"The Metropolitan Board of Works may defray the "expenses incurred by their order in the preparation and pro-"motion of the said Bills, and preliminary and incidental thereto, "when the same have been duly audited and taxed, as if they "were expenses legally incurred." The Chancellor of the Exchequer, however, proposes that the accounts should simply be audited before they are defrayed under the operation of this Bill. It is not quite clear what this audit means. Sir James M'Garel Hogg has brought in a schedule to the Bill, which shows that the amount disallowed by the official Auditor was £6611. During this year a further sum of £7035 has been paid or is payable. Is it meant by an audit that each of the accounts making up these totals shall be gone into? If so, there is a vast amount of work before an auditor and a taxing-master. We notice that the Engineers figure in these accounts for some £6425; Counsel netted £1045; Chemists, for analyses and as witnesses, over £1700; and Parliamentary Agents, £1378. Does Mr. Monk mean that all the accounts making up these amounts shall be duly audited and taxed? The total sum paid by the Board up to the 30th of June is £13,646. To this must be added

* "Notes on the Lithology of Gas Coals, with List of Commercial Analyses." By James Paterson, C.E., F.G.S., &c. Printed and published at the *Warrington Guardian* Office. 1879.

an estimated sum required to meet outstanding accounts and liabilities of £1500, making the total of nearly £15,147. We have said before that the amount is but small, considering the rateable value of this Metropolis; but the expenditure involves a principle which the Metropolitan ratepayer cannot too strictly guard. We believe that sufficient attention is not given to the expenditure of the Metropolitan Board. It is for the Vestries and District Boards to keep a tighter hold on the purse-strings of their constituents. This Bill is certain to pass; but care must be taken that the offence it condones shall not be repeated. We read in a morning contemporary the other day that Sir James M'Garel Hogg had promised never to put his hand to any Bills similar to those presented last year, unless the Government had previously assented to their promotion. With this assurance, the rate-paying public and the Water Companies may well be content, and here, for the present, we leave the matter.

Notwithstanding the efforts they have been making for months past, the Liverpool Water and Health Committees cannot agree as to the source of their new supply. One scheme is now in favour, then another. At the present moment, Haweswater seems to be in the ascendant; but, on the other hand, the Vyrnwy scheme has many supporters. The broad question would appear to be between the choice of a brown peaty water, such as can be obtained from the head of the Severn, and a bright and wholesome water such as can be obtained from Haweswater. It is alleged that the samples of water drawn from this latter source, and sent up to Dr. Frankland for analysis, were very carelessly collected, inasmuch as they were taken close to a sheep-washing enclosure, and the water may, therefore, be expected to contain all the poisonous ingredients which enter into sheep-washes. Be this as it may, we have simply to note the fact that the Town Council still defer their ultimate decision. The proposal to refer the whole matter to Mr. Bateman, C.E., seems for the present to remain in abeyance. It will probably be considered at an adjourned meeting of the Council, which should have been held yesterday, and it may be that before our next issue we shall hear that some decision has been arrived at.

Alderman Bennett still adheres to his scheme of supplying Liverpool from deep wells in the sandstone. He has formulated a series of questions, to each of which he has given an answer entirely satisfactory to himself. He believes—and who does not?—that deep-well water is, for dietetic purposes, preferable to surface water such as would be furnished by the Vyrnwy or Haweswater scheme. He appears to think—and this is the point where he will be met by his objectors—that the deep-well water is inexhaustible. Now we know that this is not the fact. Continuous pumping will dry up wells, or, as we quoted from Professor Ansted's book last week, will draw into them, from distant sources, water contaminated with sewage and saline matter, which will entirely change the character of the water originally pumped. Such an experience, we believe, has been met with in the case of the Bootle well. It is certainly remarkable that Alderman Bennett and a few friends should have renounced all faith in an extension of the well system. But perhaps we are anticipating, and must wait until next week for a decision of the whole Council.

The Town Council of Rochdale, sorely pressed, appear to have adopted a scheme of sewerage for their borough, which is to include a separate system of drainage for storm water, which is to be delivered directly into the Roach, and also an arrangement for conveying sewage proper to a point where it can be treated with chemicals, and rendered fit for discharge into the river. As to the "chemical" treatment which is to be pursued, that has yet to be decided. So many schemes are now before the public, that it is difficult to make a choice; but there is one, we rather think, which has been experimented with at Leeds and Rochdale, so that probably the minds of most members are already made up. How the manufacture of cement from Rochdale sewage might answer, we cannot tell from the analyses which lie before us; but we are inclined to think that this kind of thing is overdone. It is, of course, difficult to convert sewage sludge into portable manure, and when it has been done the value of the manure is a doubtful quantity. Rochdale, however, unless we mistake, enjoys peculiar facilities for mixing sewage sludge with more valuable material, and, perhaps, their tub system may come in to assist in making their sludge into a paying material.

We remarked on one occasion that when once the Wakefield Corporation came into possession of the water undertaking, they would sit quietly down and continue the supply from the Calder, however polluted it might be. Such, however, we are glad to find, is not to be the case. In the course of time, under the operations of the Rivers Pollution Act, the water of the river will be very much improved, and we shall never again see Dr. Frankland writing legibly with inky water taken close to the intake of the Water Company, or now, rather, of the Corporation. Still, the necessity for an increased and improved water supply for Wakefield is urgent, and we are glad to see that the Corporation are moving in the matter. They have at present two schemes before them, the most promising of which appears to be a catchment system on Rishworth Moor, near Ripponden, and to authorize which it is proposed to make application for a Bill in the next session of Parliament. It is calculated to at once supply by gravitation to Wakefield two million gallons of water per day, and if a further supply should be required, an additional million gallons. The expense of the scheme will be considerable—viz., £210,000—which, added to the sum invested in the present works—viz., £210,000—makes a total of £420,000. The interest required for the capital already invested is nearly £9000, and for the expenditure required to bring an additional supply of two million gallons per day, it is estimated that a further sum of £8090 will be required; making a total of nearly £19,000. But it is estimated that the profits of the water undertaking at the end of the next five years—by which period the new works may be completed—will amount to only £18,133, which will necessitate the imposition of a rate of twopence upon the inhabitants. We are speaking as though the Bill had been actually passed; but it would appear that a strong opposition will be made to the appropriation of the gathering-ground by Wakefield, and Sowerby Bridge and Halifax are expected to be very active in opposition. Here is another case in which it is necessary to fairly map out the gathering-grounds which can be appropriated to different towns. We are free to say that a Parliamentary Committee is not precisely the tribunal to which such questions should be referred for a decision. We must presently have a Water Commission which shall be charged with the duty of allotting water sources to the several districts interested in a supply.

Halifax is desirous of obtaining certain tracts of moorland for the essential enlargement of their water-works. Up to the present time it cannot be said that the works have proved remunerative to the Corporation, for we read that there was a deficiency of £10,000 last year. A large additional expenditure for land and reservoirs would, of course, leave a still greater deficiency; but nothing further than an expenditure of £10,000 for land seems at present intended. This, however, will leave the Corporation with an additional £400 to make up from the rates. Already the public water-rate in Halifax is sufficiently high, and economy is evidently required. If it be true that the present reservoirs are sufficient for the next fifty years, it seems clear that further expenditure for the present is certainly needless.

The Sanitary Institute of Great Britain have held their annual meeting, and have aired their well-known ideas. These are that a Government Commission should take under their superintendence all the water supplies of Great Britain. It is a grand notion, but we fear that even a Government which came into power with the maxim of "*Sanitas sani-*" "*tatum, omnia sanitas,*" would shrink from instituting such a body as is suggested by the Sanitary Institute. It is all very well for Mr. Edwin Chadwick, C.B., to suggest that the future of agriculture mainly depends upon a regular supply of water; but what would he, with his great genius, do with an exceptional year like the present? How is the rainfall to be kept off the land, and where can an excessive rainfall be stored for utilization in droughty seasons certain to come? Talk of this kind would be unworthy of notice, did we not know that Mr. Chadwick has a certain following. He knows the men who must hear him, and avails himself of his opportunities. Seriously speaking, however, there is a substratum of common sense in all Mr. Symons suggested in his paper on "Water Economy." There is this difficulty, however, that the water supply of the kingdom is vested in Local Authorities mainly, together with Companies, the latter being but little amenable to Government authority. We are far from denying that a Water Commission might not be productive of fruitful results, to which the Sanitary Institute may contribute.

Glasgow Gas and Water Supply.—From the annual report for 1878 of the Glasgow City Chamberlain (Mr. W. W. Watson), just issued, it appears that during that year 1,777,846,000 cubic feet of gas were produced, while the quantity sold and accounted for was only 1,481,329,000 cubic feet, showing a difference of 296,517,000, or 16·67 per cent. of the total quantity made. The production of the year was about 40 million cubic feet under that of 1877, but it has doubled within the last 15 years. About 30 million gallons of water were drawn from Loch Katrine, and 4 millions from the Gorbals reservoirs daily, on an average, during the year.

Correspondence.

[We do not hold ourselves responsible for the opinions expressed by Correspondents.]

THE GAS AND WATER COMPANIES ASSOCIATION AND THE APPLICATIONS FOR ELECTRIC LIGHTING POWERS.

SIR,—In replying to Mr. Livesey's letter, which appeared in the last number of the JOURNAL, relative to my remarks at Newcastle upon the Gas and Water Companies Association, I will not discuss the question as to whether the action of the Committee was right or wrong in the matter of the electric light clauses. This was not the principal object of my remarks, though Mr. Livesey has thought it right only to dwell upon this. My remarks were intended to be of wider scope, and of a more general character. They referred rather to the constitution of the Association, the general conduct of its business, and the support given to it by the Companies.

That which I aimed at was seen by yourself, as in your "Circular" of the 17th ult. it is said: "The Gas and Water Companies Association may not be all that could be desired; but whenever they fail, it is, we repeat, entirely the fault of the Companies, whose interests are watched over with the most zealous care by the energetic Secretary of the Companies Association, who is, we believe, left almost entirely to look after its affairs. A stronger combination, as Mr. Warner proposes, is undoubtedly desirable; but it can only be effected by the more hearty co-operation of the Companies themselves." Mr. Livesey himself says almost the same thing, but in other words, thus: "The comments on the Gas and Water Companies Association generally are legitimate, and the suggestions would, I think, produce beneficial results if acted upon."

Though I know nothing of the actual position of the Association, I have an impression that what is most needed is a greater interest to be taken in its working, and a higher appreciation of the value of its work. Were this attained, an accession of members, which doubtless is greatly needed, would quickly follow. The members of the British Association of Gas Managers may render good service by pressing the matter upon their chairmen, and bringing it before their boards. The Gas and Water Companies Association has a special claim upon us, too, just now, from the good work it has done through the present session. It should be borne in mind that this work could not have been done so effectually in any other way. An Association must have, if properly constituted and fairly managed, greater influence than any private combination of leading companies, which is the only next possible arrangement for guarding our common interests when attacked, and, further, the Association can grow in experience and influence, and it has its machinery always ready for work.

Now the subject has been opened up, I do hope that the estimable Secretary will be encouraged to renew his efforts to place the Association in the position it should fill.

South Shields, July 10, 1879. W. J. WARNER.

Parliamentary Intelligence.

HOUSE OF LORDS.

MONDAY, JULY 7.

Belfast Water Bill,—reported, with amendments.

Alliance and Dublin Consumers Gas Bill,—reported; *locus standi* of petitioners against the Bill not proved.

Gas and Water Provisional Orders Confirmation Bill, Newcastle-upon-Tyne and Gateshead Gas Bill,—read the third time, with the amendments, and passed.

TUESDAY, JULY 8.

Liverpool Lighting Bill,—brought from the Commons, read the first time, and referred to the Examiners.

Plymouth and Stonehouse Gas Bill,—read the third time, and passed.

Queenstown Gas Bill,—read the third time, with the amendments, and passed.

THURSDAY, JULY 10.

The Examiners reported that no further Standing Orders are applicable to the Liverpool Lighting Bill.

Belfast Water Bill,—read the third time, with the amendments, and passed.

The Knutsford Light and Water Bill was referred to a Select Committee, consisting of Earl Devon (Chairman), the Marquis of Bristol, Viscount Hood, Lord Talbot de Malahide, and Lord Annaly; to meet on Monday, July 14.

FRIDAY, JULY 11.

Blackpool Extension and Improvement Bill,—reported, with amendments.

HOUSE OF COMMONS.

MONDAY JULY 7.

Liverpool Lighting Bill,—considered; to be read the third time.

TUESDAY, JULY 8.

Liverpool Lighting Bill,—read the third time, and passed.

THURSDAY, JULY 10.

METROPOLITAN BOARD OF WORKS (WATER EXPENSES) BILL.

A petition in favour of the Bill was presented from the Commissioners of Sewers of the City of London.

On the motion for the second reading of the Bill,

Mr. MONK moved as an amendment—"That in the opinion of this House no justification is shown in this Bill for the large expenses incurred by the Metropolitan Board of Works in the preparation and in the abortive promotion of the two Bills for which they ask an indemnity from Parliament."

The House divided—

For the motion	37
Against	12
Majority for	25

The amendment was therefore lost, and the Bill read a second time and committed.

FRIDAY, JULY 11.

ALLIANCE AND DUBLIN CONSUMERS GAS BILL.

Mr. CALLAN asked the Chairman of the Committee of Ways and Means, whether he was aware that the Alliance and Dublin Consumers Gas Bill was allowed to pass through that House containing clauses which conferred, directly or indirectly, powers of electric lighting on the Alliance and Dublin Consumers Gas Company, notwithstanding the recommendation contained in the report from the Select Committee on Lighting by Electricity that "Gas Companies, in the opinion of your Committee, have no special claims to be considered as the future distributors of electric light;" whether he had any objection to state the circumstances under which the Bill containing such powers was allowed to proceed; and whether he would then, or when the Bill came back to that House, take steps to have all such powers expunged.

Mr. RAIKES: In reply to the first question of the honourable member for Dundalk, I have to say that the Bill to which he has alluded, when it passed through this House, did not contain any direct clause conferring the power to which he refers. I may further state that the Bill was read the third time, and left this House, on the 9th of June, whereas the report of the Committee on Lighting by Electricity was not presented to the House until the 19th of June. I may also say, as he has asked me to state the circumstances under which the Bill was allowed to proceed, that I have given it a great deal of attention. I had several interviews with both the promoters and the opponents of the Bill, and I stipulated that any clause directly or indirectly conferring electric lighting powers should be expunged, and that was done. In Committee, as I am since informed, a clause was inserted, at the instance of the General Post Office, which, although it conveyed no new powers, might possibly be misconstrued in connection with a paragraph in the Bill as recognizing some powers as to supplying the electric light. The matter, however, was not brought before me in this House by the parties interested; but I have since received a representation from the Corporation of Dublin on the subject, and the Bill, being then in the House of Lords, I at once communicated with my noble friend the Chairman of Committees in that House. I believe that the clause as to the electric lighting powers has been struck out in the other House, and I am quite satisfied that the Bill, as it now stands, contains no power in excess of that already granted to the Company by the Act of 1866.

HOUSE OF COMMONS COMMITTEE.

MONDAY, JUNE 30.

(*Before Mr.* A. PEEL, *Chairman; Mr.* BRASSEY, *Sir* ROBERT HARVEY, *and Mr.* HALL; *Mr.* BONHAM-CARTER, *Referee.*)

LIVERPOOL LIGHTING BILL.

Sir E. BECKETT, Q.C., Mr. POPE, Q.C., and Mr. R. S. WRIGHT appeared for the promoters; and Mr. ASPINALL, Q.C., Mr. BIDDER, Q.C., and Mr. MICHAEL, Q.C., for the Liverpool United Gas Company, petitioners against the Bill.

Sir E. BECKETT, in opening the case for the promoters, said the Bill was one for authorizing the Liverpool Corporation to raise £50,000 for the purpose of supplying the electric light, to themselves first of all, and then to "supply and sell," for use in any place or places of public resort, "light produced by electricity or other means, and meters or other fittings," or to "let meters or other fittings" for any of the purposes mentioned. When to that it was added that there was a clause in the Bill making the Corporation liable to any future general legislation there might be on the subject, that was really a description of the Bill, because all the rest was merely financial and matters of detail. There was one alteration proposed in the section authorizing the Corporation to do the things which had been mentioned. It was proposed to add the words, "Nothing in this section shall authorize the Corporation to manufacture and store gas;" and those words were put in manifestly because there was at present a Gas Company, and it was not intended to compete with them. The Committee would doubtless be inclined to determine upon the rights and wrongs of the Bill by seeing how far it complied with the report of the Committee on Lighting by Electricity; but in his (Sir E. Beckett's) opinion it did not go beyond it, but in some respects fell short of it. The first important paragraph in the way of conclusions was the third, "So far as the practical application of the electric light has already gone, there seems to be no reason to doubt that it has established itself for lighthouse illumination, and is fitted to illumine large symmetrical places, such as squares, public halls, theatres, railway stations, and workshops." It was not intended by this Bill to interfere with workshops in any public or general sense, although the Corporation took power to have workshops of their own; but that was not what the Committee meant, and in that respect the Bill fell short of the recommendations. "Although in some cases the relative economy for equal candle power is said to be on the side of the electric light, yet, in other cases, gas illumination of equal intensity has the advantage." That paragraph was intended to balance between the evidence, that for large spaces, which could be lighted by one lamp, the electric light appeared to have the best of it in point of economy, but where the lights were wanted to be luminous and diffused, that light had not the best of it. Having read several other paragraphs from the report of the Select Committee, the learned Counsel said it was proposed by the present Bill to light St. George's Hall, the Free Public Library and Museum, the Walker Art Gallery, and other public buildings which were the property of the Corporation. It might be mentioned that there was already a steam-engine in St. George's Hall, which was required for various purposes during the day, and could be very well employed during the night in generating electric power, and sending light not only into St. George's Hall, but across the streets to other public buildings—for instance, to the Alexandra Theatre, immediately opposite, if arrangements should be made for that purpose. Then there was the North-Western Hotel and the great Lime Street station of that railway company, and the promoters believed that the railway authorities would be glad to make arrangements for lighting. But that could not be done without going across the street, and they would thereby come in contact with the telegraph wires near enough to make the Postmaster-General anxious, or to give him a right to a *locus standi*, and a right to say everything he could with regard to the protection of his wires by keeping the Corporation at a proper distance; and, therefore, it was necessary that there should be an Act of Parliament for the purpose of that control, and also, no doubt, for the purpose of any slight interference there might be with the gas-pipes. There was one paragraph in the report which had a very important bearing upon the only opponent—as regarded the preamble of the Bill—viz., the Liverpool Gas Company. It was, "Gas companies, in the opinion of your Committee, have no special claims to be considered as the future distributors of the electric light. They possess no monopoly of lighting public streets or private houses beyond that which is given them by their power of laying pipes in streets." That was given them for the express purposes of their Act—for gas illumination, and nothing else—and then the Committee made the pregnant remarks: "Electric light committed to their care might have a slow development;" "Besides, though gas companies are likely to benefit by the supply of gas to gas-

engines, which are well suited as machines for producing electric light, the general processes of gas manufacture and supply are quite unlike those needed for the production of electricity as a motor or illuminant." That was as strong as anything could be against regarding gas companies as having any right of monopoly, present or future, to have anything to do with electric lighting, using it in the most comprehensive sense. Then they went on to say that they "do not consider the time has yet arrived to give general powers to private electric companies to break up the streets, unless by consent of the local authorities;" but here were the local authorities themselves asking to break up the streets for public and not for private purposes. "When the progress of invention brings a demand for facilities to transmit electricity as a source of power and light from a common centre for manufacturing and domestic purposes"—that was an important remark—"then, no doubt, the public must receive compensating advantages for a monopoly of the use of the streets." That was to say, if Parliament should ever be induced to give a monopoly of the use of the streets to any company—either a present gas company or a future electric company—then care would be taken that the public should receive some compensating advantages; but the advantage here was that the promoters were the public themselves, and there could be no conflict between them and any company on the subject. It would, no doubt, be very difficult, whenever the time came, to arrange the compensating advantages to the public, through its corporations (and it could only act through its corporations) against anybody asking for power to break up streets, and for what was here called a monopoly for the use of the electric light. In matters of a similar character to the present, somebody must take the lead, and there was no corporation in England more fitted to do so than such a Corporation as that of Liverpool or Manchester, and possibly Glasgow; but leaving them out, if the Liverpool Corporation were willing to leap into the gap and make the experiment, it was clearly enormously for the benefit of all the towns in England that the experiment should be made by a rich body. In one sense Liverpool had not been the first, for it was the fact that so long ago as 1866, in Dublin, powers were taken for the express purpose of using the electric light, founded upon what had actually taken place with regard to lighthouses before 1860; and if those powers were given so long ago in Dublin, it was surely time that the Liverpool Corporation should have them now, especially with the additional light which had been thrown on the subject. The Committee had before them two successive petitions of the Liverpool United Gas Company. The first had reference to the Bill as it was originally deposited, partly with reference to purchasing their works, and they, not unnaturally, objected to having any clause on that subject even optionally inserted until matters had been arranged with them; but all that had been struck out, and nothing more need be said about it. One paragraph in that petition stated that "the granting to the Corporation of the exclusive and other powers sought by the said Bill would subject your petitioners to undue and unfair competition." He (Sir E. Beckett) thought that that paragraph was written with a view to the Bill as it originally stood, although in words it might stretch so far as to include the present Bill; but it could hardly be fairly understood to mean that, especially as his learned friend, Mr. Michael, was of opinion that there was no competition, in a parliamentary sense, between electricity and a gas company. Then they said, "The undertaking proposed to be authorized by the said Bill is of an entirely novel and experimental character." In one sense that was true, but in another it was not; it had been used for a long time in lighthouses, and even in private buildings long enough to justify them in saying that the experiment was no longer one of doubtful practicability. They also said, "It is a scheme for the carrying out of which your petitioners submit the Corporation ought not to be allowed to charge the borough-fund;" but the Gas Company had clearly no right to say anything about that fund. In some cases corporations had only such funds as they raised by rates, and in those cases they were not authorized to promote Bills, except at the risk of having to pay the costs out of their own pockets; but the present case was not one of that kind, and therefore the allegation had nothing to do with it at all. In the case of Liverpool, they had a surplus income of their own, not arising from levying rates.

Mr. MICHAEL: May I remark that this does not point to the expense of promoting the Bill, but to the charges which may be thrown upon the borough-fund in carrying out the provisions of the Bill.

Sir E. BECKETT said that, *quâ* Gas Company, they had no more right than anybody else to be heard, and the Referee knew that no ratepayer had a right to be heard against charging the borough-fund with the expenses.

The CHAIRMAN inquired where was the proposition in the Bill to charge the borough-fund.

Sir E. BECKETT said there was no direct proposition at all. They were only authorized to borrow £50,000, and, no doubt, in one way or another, that charge would come upon the ratepayers of the town.

Mr. MICHAEL: I think it says so directly in the Bill.

Sir E. BECKETT admitted that if the Bill failed, the charge in the long run would come upon the ratepayers; but his contention was that the Gas Company had no more rights than any other ratepayer in Liverpool had.

Mr. MICHAEL: I do not dispute that.

Sir E. BECKETT said, as they were agreed upon that point, he would not pursue it further. The next allegation was, "The carrying out of the proposed undertaking would necessitate much additional breaking up of the streets." Again, what had that to do with the Gas Company? The Corporation were the masters of the streets, and if anybody wanted to break up the roads, the only persons who could be heard against it were the Corporation. It would also "interfere with the traffic along the same, and with the mains and pipes of your petitioners, and would cause inconvenience and expense to the public, and loss and injury to your petitioners." The Gas Company had, no doubt, a right to be heard on the latter point, but it was only a question of clauses. They had been invited to send clauses on that subject, but that had manifestly nothing to do with the principle of the Bill. "The estimates of the probable amount required for the undertaking are insufficient." That was idle, because they had nothing to do with it. "The cost of supplying light by the means proposed by the Bill would be much greater than the present cost of supplying gas by your petitioners." That was an argument against the Corporation supplying electricity to themselves. Look at what they might do. They could light St. George's Hall and the open spaces round, but they could not light the Free Library and other places connected with it without crossing a street, although they could erect steam-engines at each of these buildings, and they had a right to do so. The London and North-Western Railway Company could also erect an engine of their own, but they would rather avail themselves of that belonging to the Corporation, and permission to do so by merely laying a wire across the street was asked for. There was one paragraph to which the attention of the Committee must be called, because it was very amusing:—"The passing of the proposed Bill would inflict very great and unnecessary loss on the Shareholders in the petitioners Company (many of whom are in a humble position in life) without conferring any countervailing advantages." He (Sir E. Beckett) wondered whether they could persuade a jury at Liverpool, the next time they had a compensation case, to take into account the humble position in life of many of their Shareholders. Then came the supplementary petition, which stated that "Although your petitioners still hold the views expressed in their said petition, and maintain the truth of the statements therein contained, yet, if your Honourable House should, notwithstanding, deem it desirable to authorize any scheme for lighting, by electricity or otherwise, in thoroughfares or other places within the towns and townships now lighted by your petitioners"—"other places," it might be observed, comprehended private places as well as public—"your petitioners submit and respectfully urge that the necessary powers for carrying out any such schemes should be conferred on your petitioners, in such manner and on such conditions as your Honourable House may deem fit, and not on any other municipal corporation or other local authority, or public company." It was but natural they should have argued in that way before the Select Committee had reported, but, after that, they submitted that the Municipal Corporation should not have the power to do exactly that which the Select Committee thought the Corporation should have power to do. They submitted, further, that the Gas Company ought to be considered as having a monopoly of the thing which the Select Committee had negatived over and over again.

Mr. MICHAEL: Upon which the Committee had no evidence; none of those people were represented.

Sir E. BECKETT said they had heard his learned friend, and also Mr. Livesey, who was called as the Manager of a gas company. Then there was Mr. Woodall, of the Phœnix Gas Company; Mr. Sugg, the well-known manufacturer of gas apparatus; and Mr. Hunter, the Engineer and Manager of the Corporation Gas Department at Salford.

Mr. MICHAEL: Surely he did not represent a gas company.

Mr. E. BECKETT said he represented gas interests. He did not, however, think he need go further, but would invite the Committee to consider the simple question—Did the present Bill go beyond the recommendations of the Select Committee? If it did, of course it would not be passed; if it did not, it seemed equally necessary to follow that it would be passed.

The following evidence was then called:—

Mr. *George F. Deacon*, examined by Mr. WRIGHT.

I am Engineer to the Corporation of Liverpool, and also Inspector of Gas Lighting. I have for some years given great attention to the question of electricity, and latterly to electric lighting. One of the places at which an experiment is proposed to be tried is at the St. George's Hall, which is surrounded by large open spaces. The distance from St. George's Hall to the North-Western Hotel is, I should say, about 280 feet, and the station is directly behind it. In the immediate vicinity are three of the most important public buildings in Liverpool—viz., the Walker Art Gallery, Picton Reading-Room, and the Free Public Library and Museum. Behind St. George's Hall is a large public churchyard. Preparations are being made for lighting the Picton Reading-Room by electricity. The advantages of electric light increase as the space to be illuminated is equal in its dimensions in different directions. A large open space is much more economically lighted by electricity than an elongated space, and therefore those areas are remarkably well adapted for the purpose. There is a very large amount of traffic to the North-Western Hotel and to the Alexandra Theatre. The London Road and Islington are two of the main outlets from Liverpool, and the streets to the right are likewise main outlets. There is also a large amount of cross traffic entering from St. George's Place to the North-Western Station behind the Hotel, both from the left and right sides, and there is the ordinary Lime Street traffic in addition. The neighbourhood of the landing-stage is also peculiarly well suited for such lighting as this.

By the COMMITTEE: The landing-stage is quite a quarter of a mile long. The principal approach, which is a floating bridge, is lighted by gas, every alternate lamp being paid for by the Dock Board, and the intermediate lamps by the Corporation. When I first reported to the Corporation on the subject of the electric light, it was somewhat unfavourably as regarded the cost of the only systems that were then in operation for public lighting, but since that time I have studied the subject independently of the practical results which had been obtained, and I will give a few figures. Taking the case of Lime Street and the neighbourhood, we might place three electric lights, one in St. George's Place, one near the fountain on the right-hand side, and another about half way between the two. Each of those lights would have a power of 1200 candles, and if reflectors, properly constructed, were employed in connection with them, we might increase that to at least 1400 candles, and that is a very moderate estimate. The total number of lamps, therefore, would be 1400 multiplied by 3 = 4200 candles with three lights. We should probably replace about 50 lamps. We should get at the darkest points between the electric light and the illuminating power, which is proportional to the number of 641—that is, simply a number proportional to the lighting of the darkest place—that is to say, between these lights. The corresponding proportional number for the existing lighting is 0·27, giving a multiple of 2·38 in favour of these particular electric lights.

Mr. BIDDER: Do these figures represent the illuminating power?

Witness: No, not the candle power. They represent the absolute illumination on the surface of the ground, or against a screen placed in a most unfavourable position—that is, half way between the lights.

By Mr. MICHAEL: The proportional number is obtained by taking the number of yards distant from a single light to the point which is least illuminated, squaring that number, and dividing the actual power of each light by the square of that number. Take the same of all the results, and a proportional number is obtained which is proportional to the light in question.

Mr. WRIGHT: Putting it shortly, the illumination by means of the electric light, as you propose to put it, would be at the darkest point 2½ times as great as the present illumination at the darkest point by gas-light?

Witness: Yes.

Examination continued: There is at present in existence at St. George's Hall an engine which might be utilized. The particular calculation I have made was on the assumption that that engine would be used for working the three lights I have spoken of, and the three lights in the Picton Reading-Room in addition. The efficiency of any system of electric lighting must depend to a great extent upon the distribution of the light, and also on the extent to which the light is practically reduced by the globes which are put round the lights. The loss due to the globes in the systems which have been generally adopted amounts to 59 per cent.; but I think it is possible to overcome that by a judicious use of reflectors. It may be said that reflection can be adopted in connection with gas, but that is scarcely the case; it cannot be adopted in relation with gas to the same advantage, for many reasons. First, the number of reflectors to be kept clean and maintained is very much increased; secondly, the gas-flame causes smoke, which prevents the reflectors from doing their duty properly; and thirdly, the gas-flame not being a point, like the electric light, is not so efficiently distributed by reflection. There are a large number of markets and drill-sheds in Liverpool which might be efficiently lighted by electricity. In large rooms there are many sanitary and acoustic advantages in the use of the electric light. The combustion of oxygen is infinitesimal, and there is scarcely any heating effect on the air. It is a

matter of old and long observation that concerts held in the daytime are more perfect than those held at night, and that, I think, unquestionably arises from the greater homogeneity of the air during the day and the heterogeneity of the air at night, which is caused undoubtedly by the heterogeneity of the temperature produced by the gas. I have turned my attention to the question of the distribution of power generated through electricity, which appears to me to be a very important point in connection with electric lighting. At present we have in Liverpool a very large number of small engines, used in warehouses for hoisting and for driving machines, and for various applications of that kind. These engines are exceedingly wasteful, as a rule, and I think I am on the safe side when I say that they consume, on the average, from 8 to 10 lbs. of coal per horse power per hour; but there is no difficulty in erecting engines of large size, which will consume only from 2 to 3 lbs. of coal per horse power per hour. We have it in evidence, which I think is incontrovertible, that a dynamo-electric machine, driven by an engine consuming from 2 to 3 lbs. of coal per horse power per hour, will, at the other end of the electric wire, drive an electro-dynamic machine with a loss, say, of only something like 50 per cent.—take 40 per cent. if you like.

By the COMMITTEE: I cannot give the distance accurately, but I think it would be quite sufficient for all practical purposes. I was going to add that that gives practically from 4 to 6 lbs. of coal per horse power per hour at the point at which the small engine is giving off its power, as against 8 or 10 lbs. per horse power per hour as at present. I think those figures are very moderate indeed, and therefore I see a very great economy by the use of the power generated at central stations through the agency of dynamo-electric and electro-dynamic machines. So far as the postal telegraphs are concerned, in my opinion there is not any practical difficulty in arranging the wires so as to avoid them altogether.

Cross-examined by Mr. BIDDER: The Corporation of Liverpool, amongst other things, ask for power to supply dynamo-electric power, but I cannot say that I contemplate it as an immediate result, although I think we have a right to look forward to doing so.

By the COMMITTEE: I believe it would be quite practicable to reproduce from 40 to 50 per cent. at a length greater than St. George's Hall, but I have not the figures before me with regard to the matter. The lengths may be very great if the size of the wire is only increased.

Cross-examination resumed: Taking the length of St. George's Hall, the diameter of the wire which would convey, with a loss of power not exceeding 50 per cent., one-horse power, would not exceed half an inch. That is a fact founded on observation.

Mr. BIDDER: The figures you have given rather tend to show that a much better result can be obtained by electricity than by gas?

Witness: I believe that for the same cost, in that particular instance, it will be the case.

Under the instructions of the Corporation you made an investigation into the matter, and reported to them, in the course of last October, and, unless I misunderstand your report, I think the conclusions you there arrived at are hardly consistent with that view, are they?—I think they are.

Let me draw your attention to that report. At page 6 you say: "The light from each regulator cannot be efficiently reduced below 1000 candles, and gives a much higher efficiency when increased to 10,000 or 15,000 candles. Regulators giving 6000 candles each are very commonly used. The most favourable place for the employment of such a regulator would be the centre of a circular space. If such a space were 500 feet in diameter, the light in the centre line of a circular carriage-way just within it would be greater than that in a Liverpool street illuminated in the ordinary way. To illuminate the whole area with gas rather better than the electric light would illuminate the centre of the supposed carriage-way, would necessitate the use of only about 125 Liverpool street-lamps of 16-candle power each. Thus with gas-lights having an aggregate power of only 2000 candles, a better effect is produced than with the electric light having a power of 6000 candles, even in a case particularly well adapted to give the best results attainable from a concentrated light." Unless I misunderstand those words, they seem to me very clearly to enunciate your opinion, that, under the most favourable circumstances, the result, as regards general illumination, is much more satisfactory with gas than with electricity?—No; that clause as stated there is absolutely correct. It is given in order to show what I thought at that time was most important—namely, that the Corporation and the public should know that the question of gas lighting *versus* electric lighting was not a question of candle power.

As you have told us to-day?—Yes, and as I admit; but in this particular ideal instance, this circular carriage-way of 500 feet in diameter is a particularly favourable case.

For electricity?—Yes; but the gas-lights are assumed to be placed at equal distances—a condition which is absolutely an impossibility in a street. You cannot jot the gas-lights about in the centre of a carriage-way, even in a very wide street, in such a manner as to show all, if at uniform distances apart; if you could do it in the centre of a carriage-way it would work out so.

That is to say, to light the same area with gas in such a way that the least light at any point shall be equal to the least light in the case of electricity, will only take gas represented by 2000 candles?—In this particular instance, yes; the gas-lights being placed in the most economical position possible, without any building or any other conditions. This is, however, absolutely an ideal case, and one which does not exist in the world, I believe.

Although it is an ideal case, it is one which is particularly to the advantage of electricity?—Yes; and also particularly to the advantage of the gas.

You do not say so. What you said was that it was "particularly well adapted to give the best result attainable from a concentrated light;" you mean electricity by that, and not gas?—Yes, certainly; but you cannot conceive a case better adapted for lighting by any method whatever. You can get the greatest possible light with the least possible cost in a large space of that kind, by whatever method you light it.

To put it beyond all doubt, I see you have added a foot-note which throws a little further light upon it: "In the particular example adduced, much additional light might be obtained at the boundary of the circular space by the use of a properly constructed reflector. But the conditions assumed are exceptionally favourable to the electric light, and, under ordinary circumstances, even with the best reflectors, the discrepancy would not be less than is thus shown." Therefore I am afraid you have left yourself no loophole for escape by that foot-note, because if those words mean anything, they mean that in any ordinary case the discrepancy would at least be as great?—Yes; I believe I thought so then, but it must be remembered I did not enter into the question of cost. There the 6000 candles may be obtained more cheaply than the 2000.

I am going to read a passage in which you point very distinctly to this question: "Including interest on the cost of the lamps, price paid for the gas and for lighting, repairs, and painting, each public lamp costs the Liverpool Corporation about 0·243d. per hour when in use. The comparison for equal illumination of the centre line of the carriage-way in each case would, therefore, be—92 Jablochkoff candles, at 7·680d. per hour, £1 0s. 6d.; 165 Liverpool gas-jets, at 0·243d. per hour, 3s. 4d. But such an illumination as either of these methods provides is immensely greater than has ever before been thought desirable for permanent use. To illuminate the Avenue de l'Opéra to the same extent and at the same cost per unit of area as the best-lighted thoroughfares in Liverpool, would involve the use of only 47 gas-jets, at a cost, as before, of 0·243d. each per hour. The total cost of lighting, according to the highest Liverpool standard, would therefore be 11·42d. per hour. In terms of illuminating power, therefore, the electric light in question costs at least six times as much as illumination with Liverpool gas, while in terms of the area lighted, without reference to the amount of light, it costs 21 times as much." That rather gets rid of the hypothesis that, perhaps, you might get 6000 candles cheaper than 2000?—No, it does not, indeed.

If it costs 21 times as much, it cannot be cheaper?—I will explain that point. In the first place, as I have already pointed out, there is an immense loss in the Avenue de l'Opéra by the irregular spacing of the electric lights. In my estimate, I space the gas-lights in the most economical manner. In the second place there is an enormous loss in consequence of the absorption by the opal globes. In the third place, there is a considerable loss by the use of alternating currents. In the fourth place, there is a considerable loss by the fact that the reflectors are not used to cast the light downwards in the proper direction. In the fifth place, there is a considerable loss by the subdivision of the light, which is not contemplated in that particular case. All these taken together, I believe, more than make up the discrepancy. I took the Avenue de l'Opéra as I found it.

I suppose you had all these considerations before you when you wrote your report?—No, I had not. I mentioned about the opal globes in my report; but I do not contemplate using them now, nor some such substitute for them.

You are going to have frosted globes, are you not?—If you will allow me, I will read this passage from my report: "Reverting to the Avenue de l'Opéra, it has been already shown that the opal globes obstructed 58 per cent. of the light. The globes are simply used for the sake of appearance, and to avoid the great intensity of the naked light; but the latter object may be attained by reducing only those rays which reach the eye when moderately near the lamp. By a modification of the globes, therefore, the efficiency of the Jablochkoff candles may be multiplied more than twice; and by the proper use of reflectors, by which the rays which would otherwise fall on buildings, and pass upwards, would be directed to the darker spaces between any two lights, the efficiency may be still further increased. There is also a serious loss due to the mode of subdivision adopted, the amount of which, however, is less certain, and a loss of probably 20 per cent. arises from the use of alternating currents. Unfortunately, the only lamps hitherto applied in practice, to which none of these objections apply, are the ordinary regulators, one only being placed on each circuit, and worked by dynamo-electric machines giving currents of constant direction. Here the great loss from concentrated light, already adverted to, comes into play; but even this disadvantage is so far smaller than the aggregate of the others, that the same degree of illumination could be attained in such a thoroughfare as the Avenue de l'Opéra by about seven concentrated lights, at less than half the present cost." I should never recommend the Liverpool Corporation to light on the system in force in the Avenue de l'Opéra. I ought, however, to add that the figures which have been quoted here were the prices charged during the Exhibition year in Paris, and were very much higher than those now quoted by the Company.

What did you mean by saying, "In terms of the area lighted, without reference to the amount of light, it costs 21 times as much"?—I meant that the intensity of the light was so much greater in the Avenue de l'Opéra, that, if I assumed it to be a Liverpool street only that was required to be lighted to the degree of intensity which is adopted for public illumination in Liverpool, then the lighting, without taking into consideration the advantage of the greater intensity of the light, would be 21 times as costly. It is perfectly correct.

You have pointed out in your report that the extra intensity, so far from being an advantage, is to be reduced by either opal or frosted globes? I do not think so.

What is the object of adopting those globes if it is not to prevent the intensity of the lights blinding the eye?—I have been puzzled to know why they should be adopted, and I think everybody else who has been in Paris has also been puzzled. The effect is, perhaps, rather more pleasing with opal globes than without them, but, as a matter of economy, they are certainly not desirable.

Mr. BIDDER: Let me draw your attention, in order to see that I do not misrepresent you, to the conclusions at the end of your report, in which you sum up your investigations as follows——

Mr. POPE: Up to that time.

Mr. BIDDER: "The Engineer is of opinion"—at the time his report was written, in October, 1878—"first, that the cost of the only system of public lighting by electricity at present in use is six times the cost of Liverpool gas producing the same degree of illumination, and 21 times the cost of Liverpool gas which would, under ordinary circumstances, be consumed in the illumination of the same area."

The CHAIRMAN: Will you look at the last six lines of your report, where you appear to have made a further summary, and say that you "will then be enabled to report exactly as to the relative cost of gas lighting and of the various systems of electric lighting when applied in the most economical manner in Liverpool"? Has any comparison of that kind been made?

Witness: I have not yet made a further report. The report quoted from was an interim one of undoubted facts, and they are not in the slightest degree inconsistent with the facts which I state now.

Your fifth conclusion was, "That the spaces north, east, and west of St. George's Hall, Liverpool, are well adapted for lighting by electricity; and, as a new engine has lately been erected in the basement of the hall, for pumping to the Steble Fountain, the Engineer recommends that such dynamo-electric machines, to be driven by that engine, be obtained as will enable the Corporation to make a fair trial of various systems for the illumination of the spaces in question. Estimates have been obtained from various makers for the supply of the necessary apparatus." Has that recommendation been carried out?—It has not. At the time that report was made it had not been determined to obtain an Act of Parliament. One reason why I have not tried it personally is that the Picton Reading-Room is not quite completed. The whole work must be done economically, and at the same time. I have not estimated whether the cost of the experiment would or would not have been less than the cost of promoting the present Bill. I was examined before the Select Committee on Electric Lighting, but I gave no evidence of the relative cost of electric lighting and gas lighting. I stated that if the Avenue de l'Opéra had not been so particularly favourable to the electric light—if it had been a narrow street—the result would have come out more favourable still to gas; but I have not proposed to light any narrow street with the electric light. I believe in the possibility of diminishing the cost by dividing the lights; within certain limits it has been done. I do not believe it is possible, in the present state of affairs, to make two lights instead of one, at half the cost

of each. I am advised that we require this Bill to empower us to take up the pavement. We have not tried to do so, and been stopped from proceeding. I am aware that competent authorities have advised that we have the power, and that evidence was given before the Select Committee on the subject.

Mr. BIDDER: I see that the marginal note to clause 3 of your Bill is, "Power to supply electric or other light for public or private purposes;" so that you not only contemplate illuminating St. George's Hall and the approaches to the landing-stage, and possibly some other avenues, but also supplying electric light for private purposes?

Witness: I do not think that at all likely.

Mr. POPE: The words in the filled-up Bill are, "In any place or places of public resort."

Witness: That means railway-stations, theatres, and music-halls, but I do not know whether hotels are contemplated, although there is no reason why some of the rooms in the large hotels should not be lighted by electricity.

Mr. BIDDER: When you come to light the theatres, music-halls, and hotels by electricity, what is going to be the effect upon the business of gas companies?

Witness: I do not think that such lighting as is likely to take place, having regard to the state of the invention up to the present time, will permanently depreciate the value of gas shares.

I did not ask you anything about the effect on gas shares; but is it not obvious, if you carry out your intentions, you will deprive the Gas Company of the custom of all these large public places of resort?—The use of gas in the particular places in which we provided the electric light would, of course, be gone; but, to counterbalance that, there would, I believe, be a very large use of gas in gas-engines for driving dynamo-electric machines. I am inclined to think, also, that the time is coming when the public will demand increased illumination generally in all places of great traffic. I am satisfied that when gas companies find that their 10 per cent. is not quite so easily made, they will discover other uses for gas, in the way of heating, to which it is not now applied.

The CHAIRMAN: I do not see that we have anything to do with the effect of this upon the Gas Company or the gas shares.

Mr. BIDDER said, with great respect, that the whole question before the Committee was whether the Corporation were entitled to ask for parliamentary power to do a thing which would injure the Gas Company, which had a parliamentary position; or, if granted, upon what terms, so as to protect the interests of the Company. Before many Committees there had arisen questions as to the transfer of water and gas undertakings into the hands of corporations, and in every case the most important question which the Committee had had to deal with had been upon what conditions and what terms, for the protection of the existing parliamentary company, they would grant the power asked for.

The CHAIRMAN: The only protection we have to consider is whether the existing rights of the Gas Company are interfered with, and their property unduly touched in respect to taking up their gas-pipes, or interfering with their supply to their customers. I do not see how the Engineer can go into those questions.

Mr. BIDDER: I must lay a foundation of fact with the Engineer. You, Sir, were the Chairman, I think, of the Committee on the Stockton and Middlesbrough Bill, the question there being practically, though it was fought out in a different form in different years, whether the Corporation should obtain the water supply of the town. They ultimately obtained it, but only upon the condition that they should purchase the rights of the existing Water Company at rates which were enormous. In this case, we are precisely in the same position as that Water Company were. We are, under the authority of Parliament, the Lighting Authority of the town of Liverpool, and nobody else can light that town. With the sanction of the Town Council themselves, and with the sanction of Parliament, our capital has been invested for that purpose, and I do not hesitate to say that the most important question for you to consider in this case—when one of the two parties to that bargain is coming forward, admitting that without parliamentary power they cannot interfere with our business, and asking you for powers which it is admitted will make it difficult for us to earn our dividends—is upon what conditions you will grant it.

Witness: I do not admit that.

The CHAIRMAN: Of course the rights of existing companies are preserved. This is not a proposal on the part of the Corporation to light the whole of Liverpool with the electric light.

Mr. BIDDER: It is a proposal to light the streets and places of public resort, and thereby to take the cream of our business away from us.

Mr. POPE: It is no more a proposal to take the cream of your business away from you than the proposal to make a railway from Manchester to Liverpool was a proposal to take the cream of the coaching traffic away.

The CHAIRMAN: We will leave it to the learned Counsel to pursue his own course.

Cross-examination resumed: As a matter of fact, we break up the streets ourselves, and give permission to others to do so for certain purposes. We have express statutory powers to give authority to lay down rails across the streets in places in which both sides of the streets are owned by the party making the application. I have no doubt we have given authority to the Telegraph Company to lay their wires under the footpaths, but they had the power to do it.

Mr. BIDDER: If they had power to do so they would not have asked you to allow them to do it.

Mr. POPE: They had authority to do it with the consent of the Street Authority.

Witness: They had power to lay their wires either overhead or underground, and I apprehend the Municipal Authority have power to lay them underground, if they like. A difficulty, however, has arisen, and it is proposed to take them overhead, and not underground.

Re-examined by Mr. POPE: If we have the power to do any mischief to the Gas Company without an Act of Parliament, our obtaining that Act will not do them any harm. Another point is that, supposing, only for the sake of argument, the whole of the public lighting in Liverpool were done away with, it would be a mere trifle in the accounts of the Gas Company. Since the report of the Select Committee was issued I have had a communication from Messrs. Siemens Brothers with reference to the advantage of placing the electric light at a high elevation, instead of on a level with the eye, so as to diffuse the light over a larger area, though diminished in intensity. On that point I may, however, say that there are some practical objections to placing an electric light very high in a town; but I think the difficulty may be overcome by diminishing the intensity of those lights which fall very nearly vertically to the ground—and which are, therefore, very intense as you approach them—by means of opal saucers, which will not obstruct the light passing to greater distances; and then, if above the light properly constructed reflectors are placed, the whole of the light may be utilized that would otherwise be lost by passing upwards, and it may be thrown to a great distance and also downwards.

The CHAIRMAN: It is not very clear what the provisions of the Bill are. When I say that we have nothing to do with the effect of the passing of this Bill upon the Gas Company's shares, of course I am aware that in the petition there is a clause pointing out the effect which it is believed would be produced upon those shares by the passing of this Bill, and, therefore, that point is before the Committee; but, since that petition has been lodged, I understand an alteration has been made in the Bill, which is the foundation of my remarks—that is to say, that the Corporation may supply and sell by agreement for use in any place or places of public resort. How can anybody be injured if there is an agreement necessary?

Mr. BIDDER: By agreement with the persons to whom the place of public resort belongs; not agreement with us. It means, for instance, agreement with the London and North-Western Railway Company.

Mr. POPE: No doubt, *quoad* the public places of resort, it would be competition between the electric light and the Gas Company.

The CHAIRMAN: Is there any compulsory power given to interfere with the mains of the Gas Company?

Mr. POPE: None whatever.

Mr. BIDDER: That is conceded.

Mr. POPE: In the hands of the Corporation it would enable the new mode of lighting to enter into competition with the existing lighting by the Gas Company. If it turned out satisfactorily, within the limits of the Bill, of course electric lighting would be used instead of gas; if it turned out unfortunately, still the Gas Company would hold their own. It is nothing but the competition of a better mode of lighting with the present mode of lighting, and not interfering in any way with the powers of the existing Company.

Dr. *C. W. Siemens*, examined by Mr. POPE.

I know the open spaces round St. George's Hall, Liverpool, and the approaches to the landing-stage, and I consider they are very favourably situated for trying this experiment of lighting by electricity. The result of those experiments would prove the comparative advantages and the comparative cost of the one system and the other. The question of cost is composed of two elements—the one is the necessary consumption of something to produce the effect, and the other is the incidental expense connected with its application. With regard to the first, the necessary expenditure of energy to produce light by gas and the necessary expenditure of energy to produce light by electricity are at present pretty well understood. We know how much energy is necessary, and how much expenditure of coal is necessary, to produce a given amount of illumination by gas, applied under the most favourable conditions, and how much would be necessary in obtaining the same amount of light by means of electricity. But the second question, how the new mode of lighting could be best applied under given circumstances, is a matter that can only be finally determined by experience.

Mr. POPE: We have heard something about the wastefulness of the electric light, by reason of the necessity to obscure it to make it even endurable at all. Have you considered how it could be most economically applied, so as to avail yourself of the whole quantity of light?

Witness: I have considered that question, and I think that the electric light should be treated very differently, as regards position, from gas light, which must be placed near the object lighted, because its illuminating power is limited; or even if oil or candles were used, they would have to be placed still nearer the object to be lighted. Solar light diffuses itself over the whole surface of the earth, and penetrates to every room and space, though the sun is far removed from the surface of the earth. The electric light, being nearly of equal intensity to the solar light, should be placed at a considerable distance from the objects lighted; otherwise it has to be reduced in intensity artificially, to be brought to the same level, or nearly so, as gas lighting, because if that were not done, it would be intolerable to the eye. I have considered the question of electric lighting as an engineering question, and have arrived at the conclusion that, in order to get beneficial results by means of the electric light, that light must be placed at a considerable elevation, in which case it is not necessary to obscure any large portion of it by means of opal or semi-transparent bodies, because the light will be removed above the lines of vision. On the other hand, if the light were too much subdivided, it would have to be placed near the objects lighted, and the inconvenience would arise of bringing the source of light, which is intense, within the lines of vision.

That would seem to me to point rather to the utility of electric lighting for large spaces, where you can diffuse the light over a large area from an elevated position, rather than for domestic use, where it would be brought immediately upon the object sought to be lighted?—Decidedly. It is generally supposed that the power of the light diminishes as the square of the distance at which it is placed; and a good deal of misconception has arisen from that view, which is true only in a certain sense. Light, if placed at a greater distance, loses practically nothing in consequence of that distance. The portion of that light which falls upon, say, a square foot of space, diminishes as the square of the distance, but it will be found that if the source of light is placed at double the height, it will light four times the area. Therefore, the total amount of light which is utilized is exactly the same, whether the light be placed at a considerable or an inconsiderable distance. Holding these views, I look with great interest at to be tried experiments such as those proposed in the large open spaces at Liverpool.

By the COMMITTEE: The height at which the electric light should be placed depends upon the breadth of the place; in the particular locality mentioned, I should say about 50 feet. I agree with the previous witness that the distribution of power might take place through the same wires as the light was conducted through, but, of course, not at the same time.

Mr. *A. Bower*, examined by Mr. POPE.

I am a member of the firm of George Forest and Co., engineers, Liverpool, and a Town Councillor and a Justice of the Peace. I have given very considerable attention to the subject of electric lighting. In the interests of the town I desire to see all our public squares and large places lighted by the best possible means. Practically the electric light consumes none of the air, whereas I should say, in a building filled in an ordinary manner, gas consumes and vitiates more air than the human beings in the building do.

Cross-examined by Mr. ASPINALL: There is nothing to prevent railway companies lighting their stations by electricity, if they wish to do so, providing they do not interfere with the public streets. I do not think it would be a fair stretching of the term "places of public resort" to include shops, for instance. The Corporation have no intention to twist those words into anything but what would be their fair and legitimate meaning. The purchase of the property of the Gas Company has been a subject of debate, but it has been opposed by the great bulk of the Corporation.

Mr. POPE: When the Bill was introduced it was during the "scare," when it was supposed the electric light would supersede gas. It was thought possible Parliament might say, "If you take power to light by electricity, you must buy up the Gas Company," and therefore we took that power.

Mr. ASPINALL: You had a Committee in 1877 to confer with the Gas Company in respect to the purchase of the works?

Witness: Some questions were asked; that was all.

Was not this the action of the Committee: "In order that this question may be determined by the Council, your Committee beg to recommend that they should be empowered to negotiate with the Gas Company for the purchase of the gas-works at a price to be agreed on between your

Committee and the Gas Company, subject to the approval of the Council and the sanction of Parliament"?—That was the recommendation of the Gas Committee, but it was not acted upon.

Was it not adopted by the Council in these words: "That the Committee should be empowered to confer with the Gas Company as to the possible purchase of the gas-works at a price satisfactory to the Committee and the Gas Company"?—I do not think it was; it was not entertained by the Council.

Mr. *J. Rayner*, examined by Mr. WRIGHT.

I am the Town Clerk of Liverpool, and advised the Corporation as to the necessity of obtaining parliamentary powers in this case, first for borrowing money, and then to acquire licences from the patentees. I also thought it would be the safest course to take express power to break up the streets, and likewise for the protection of the Postmaster-General; otherwise, if we applied the electric light, he would not get sufficient protection under the present Telegraphs Acts. So far as I have been able to give consideration to all the decisions, the conclusion I have arrived at is that if the Corporation broke up the streets without express power, a jury might find them guilty of a nuisance—a verdict which a Court of Law would not disturb; and that view is strengthened very much by the 161st section of the Public Health Act, to which Mr. Michael referred in his evidence before the Select Committee on Lighting by Electricity.

Cross-examined by Mr. ASPINALL: I am familiar with the recent case of *The Edgware Highway Board v. The Harrow District Gas Company*, but that does not alter my opinion. In that case it was agreed that if the plaintiffs would give the defendants a licence to open a highway in their jurisdiction, the defendants should make good the surface of the road, and pay to the plaintiffs 1s. per yard of the highway so broken up. It was held that the contract was valid, because the agreement of the plaintiffs to allow the defendants to interfere with the surface of the road was a good consideration; and that the contract did not necessarily contemplate the creation of a nuisance by the defendants. That does not touch the real question if the Corporation were indicted. Although the railway company might light their own premises if they liked, without committing a nuisance, they might find it more advantageous to agree with the Corporation to light them, by using the same electric power as that employed for lighting St. George's Hall. The view the Corporation took was that if they were put to extra cost in lighting more efficiently a space serving as an approach to the railway station, it would be a reasonable thing if a part of the expense could be recouped by agreeing with the Company to use the same appliances. The Courts of Law have decided what are places of public resort, and those places we intend to light by agreement, if we obtain the power. They include railway stations, markets, streets and squares, public halls, churches and chapels, if open to the public, and the landing-stage. I have not considered the question of whether a considerable portion of the Gas Company's business would be taken away; but, no doubt, if people find it more advantageous, they will enter into agreements with us. We are not seeking to enter into competition with the Gas Company, and I think the word "competition" is misapplied altogether. It might as well be said that railways were in competition with the coaches which they superseded. We do not seek to light hotels; but I think theatres would come within the meaning of the section.

Mr. POPE said that if it was desired to have a limitation placed upon the words "places of public resort," the matter should receive consideration.

In further cross-examination by Mr. ASPINALL, witness stated (on the subject of the proposed purchase of the gas-works by the Corporation) that on the 12th of September, 1877, he wrote to the Secretary of the Gas Company: "I am directed to forward you a copy of a resolution passed by the Special Committee on Gas Supply on the 22nd ult. If your Board are willing to negotiate, a deputation from the Committee will be glad to meet a deputation of the Directors." A copy of the resolution was enclosed: "Resolved, that the Directors of the Liverpool United Gaslight Company be respectfully requested to state whether they are willing to negotiate for the sale of their undertaking to the Corporation." On the 28th of September in the same year, the following answer was received from Mr. Garnett: "Dear Sir,—I have submitted to the Directors of the Gas Company your letter of the 12th inst., with accompanying resolution of the 22nd ult., and am instructed respectfully to inform the Gas Supply Committee that the Board believe the Shareholders have no desire to part with their property; but that if it should be definitely resolved by the Town Council that it is desirable in the interests of the town to acquire the undertaking, the Directors will be prepared to consider any proposals that may be made with that object. You will, I feel sure, see that any meetings between deputations of the two bodies would be premature before the Committee shall have passed such a resolution as above indicated, and delegated to the Committee authority to carry it into effect." That was the end of the negotiation.

Mr. ASPINALL said he appeared for the Gas Company, and had to submit that the Bill was a most unfair one to pass in the present condition of things; and, moreover, as introduced into Parliament, at all events, it was about as artful a piece of legislation, as regarded the interests of the Company he represented, as was ever presented. The Liverpool Gas Company had for many years lighted the great town of Liverpool, together with a large district round about, and had performed their duties in a manner which had never been complained of. No one had suggested that they were open to imputation of any kind, and therefore they might be said to be lighting the town of Liverpool under that which had always been held to be a parliamentary contract. No stronger evidence of that fact could be given than the fact that in the Borough Funds Act of 1872 there was a special provision expressly prohibiting a corporation from promoting a Bill in Parliament for the establishment of gas or water works to compete with an existing company. So far, therefore, it might be said that gas companies had been recognized by Parliament as having the strongest interest in the lighting of a town, which interest arose out of the power to do so under that parliamentary contract, and which interest was vested in them so long as they did their duty properly. That being so, in what position did the Gas Company find themselves? Here was a new agency for lighting.

Mr. POPE: You assert that you are in the position of a lighting authority with a parliamentary contract, by which the duty is confided to you to light the town. How is it confided to you?

Mr. ASPINALL said the Company had power to create their works; they were constituted into a company, and they were placed in a position in which, practically, they alone could light the town. He did not mean to say that if they did not do their duty, it would not be competent for Parliament to authorize another company to compete with them. It would also be open to the Corporation to submit their grievances to Parliament, and in such a case for Parliament to authorize the Corporation to set up other works and light the town, but without such sanction nobody else could do so. And, being practically in such a position, Parliament had, by the Borough Funds Act, declared that it would not allow the Company to be lightly interfered with, even by the Corporation; and if the latter did so, it must be at the risk of having to pay their own costs. It was part of the case of the Corporation that they could not compete with the Company without parliamentary power, because they said, however much it might be doubted, that they had not the power to take up the streets; and Parliament had indicated, by the Act of 1872, that, in their opinion, it would not be proper for a corporation to seek such power. He therefore thought he had established the position in which his clients stood as a Gas Company supplying the town of Liverpool. He was reminded, however, that by another section of the Company's Act of Parliament, they were not only empowered, but were actually bound, to light the public lamps of the town. It was quite true it was to be done under the control of the Corporation, but they were bound to do it. That being the case, they found themselves in the position of having thrust upon them an invention which was absolutely new, and which had been recently considered by a Committee of that House. Something turned upon the meaning of the recommendation which the Committee made, and which he ventured to submit was that, so far from the Select Committee having made any suggestion to any other Committee, that they should pass such a Bill as the present, they had done nothing of the kind; but what they had done was to indicate in terms, no doubt sufficiently strong, what, in their opinion, should be the action of Parliament with regard to general legislation upon the subject. Having read several extracts from the evidence taken before the Select Committee, and also from the report, the learned Counsel said that what he had to submit as his first suggestion was that the Select Committee in their report were pointing to a general Act, and not making any suggestion to a Committee sitting on a private Bill; and, secondly, he submitted that nothing would be more inconvenient, nothing more unjust to the parties he represented, than to pass a single private Bill—the only one possible during the present year—in anticipation of such general provisions as those which, if electricity was really to be a useful lighting power to the public, must be provided by Parliament within a short time. When companies or corporations proposing to light by electricity found an existing gas company which well served the public, was it not fair to suppose, when there was an Electric Lighting Clauses Consolidation Act, as they had now a Gas Clauses Consolidation Act, that it would contain some provisions with regard to what was just and fair to be done in the case of existing gas companies, who had spent their money to an enormous extent in lighting the streets of large towns? It was one of the subjects which Parliament could not help considering; it was a subject which legislation hitherto had recognized as being something which in justice ought to be considered when the thing was being dealt with. If a Select Committee of the House had recommended, as strongly as it could do, that there should be general legislation upon the subject, could it be fair that this one Bill should be brought forward, asking to give the Corporation power to do something which would bring them into serious competition with the existing Gas Company, and which might be at total variance with, and outside of, the protective clauses which might be passed in any general Act? The Corporation said they had brought up a clause for the purpose of avoiding that injustice, but that they had not done so willingly was plain from the time when they had thought proper to insert it. What effect would that have upon the shares? Supposing that next year, or the year after, a general Act was passed, giving a right to compensation, upon some reasonable terms, to gas companies, or compelling corporations to do certain things in order to prevent injustice from being done, what effect would it have upon the Liverpool Gas Company? They would have suffered an injury. Could any one doubt, who looked at the matter impartially, that the moment an Act of that sort passed, their shares would be seriously affected? If the Corporation confined themselves to the right of lighting the public lamps of the town—and that power was given by Parliament—they would be recognized as a body empowered by Parliament to act in competition with the Company, to the extent of the public streets, at all events. But they did not confine themselves to the streets; they asked for a rambling power, which they now admitted ought to be defined, but which, even if limited, would be a serious matter for the Gas Company. The Corporation proposed to light not only squares, dock spaces, and railway stations, but every place which might be brought within the words "places of public resort." Mr. Rayner himself said he thought they included theatres, who were customers of the Gas Company to a very large extent. He also said he thought it included churches, and therefore chapels, and that would take away a large slice of the business of the Gas Company.

Mr. POPE said theatres were not included.

Mr. ASPINALL said if his learned friend would suggest any general words which would include a church and not a theatre, he should like to hear them. It was obvious they were asking for a very large power of direct competition, by means of electricity, with the Gas Company; and what he asked the Committee to consider was, that there must be general legislation on the subject, if electricity should become the medium of lighting for the public advantage on a large scale. He therefore submitted that nothing was more unfair than to subject one company alone to special legislation out of the whole of the gas companies. Supposing, for the purpose of argument, he brought up a clause asking for compensation in any shape to the Gas Company for this interference, and asking that the Corporation should be bound to do certain things, what would be said? The answer would be conclusive: "You must wait for general legislation; this is too large a subject for a private committee to consider." He considered he had a right to say the same thing on his side. It could not be fair for this particular Corporation to interfere with the rights and the position of the Company by a private Act, in such a way as must necessarily depreciate their property, till Parliament, having had the subject before it, had been able to deal with the whole question, and had been able to say what ought to be done generally, without reference to this particular place, and with reference to preventing injustice from being done to existing interests. The Corporation took credit to themselves for their zeal about electricity; but if they had had that zeal apart from their interests, look at what they might have done, but had not done. In the first place, they had St. George's Hall; they had been talking a long time about trying experiments there, but they had not tried one. They had also the frontage on to Lime Street, upon which they might have tried any number of experiments, but they had not done so. Then behind there was St. John's Church, with no street between, and one could not suppose that the Ecclesiastical Commissioners would throw the slightest impediment in the way of their using that large space for experiments. With regard to the other places, likewise, there was not the slightest difficulty. The only reason which had been suggested for bringing in the present Bill was by the Town Clerk, who said there might be a difficulty, because a jury might find their breaking up the streets, in order to lay down the wires, a nuisance. But did juries, as a rule, act utterly without regard to common sense? It was for the Committee to say whether the Corporation, if they were anxious to have tried experiments, ought to have been deterred by the fear that a Liverpool jury might have such an opinion of the Corporation as to find that such an act as laying down a wire in a street was a nuisance. It might have been carried overhead, at such a height as that it would be hardly visible to the naked eye. Looking at the evidence which had been offered, not one of the witnesses had said there was any ground for legislation except in respect of the laying of the wire. It was obvious from the evidence that the Corporation had been considering the question of buying the gas-works, and as the Bill was

originally introduced it contained special powers to the Corporation to deal with the Gas Company, and to buy their property by agreement. The Bill was originally a composite one, asking for powers to use the electric light for certain purposes, and for other powers as large as they could get them from Parliament. There were a number of clauses in the Bill with regard to the purchase of the Gas Company, but they had been struck out; but it was still full of danger to the Company, because they sought for power that, "subject to the provisions of this section (clause 3, sub-section 4), they may manufacture, buy, or rent, and may sell or let any gas or fuel, or other motive power, and any materials or articles necessary for the purposes of this section." That clause prohibited the Corporation from manufacturing gas; but it gave them power to buy it without limitation, and to sell it for certain purposes. If the Corporation thought it desirable to set up works of their own, the Bill actually, as it was now framed, gave them power to buy as much gas as they wanted from any company, and sell as much as they pleased, and it gave them the power to provide the means of distributing it; so that, as the Bill stood, it was a Gas Bill. That showed the great ingenuity with which the ingenious gentlemen who conducted those matters on behalf of the Corporation, did those things. He (Mr. Aspinall) wished particularly to impress upon the Committee that the Bill did originally take power absolutely to enable them—by agreement, certainly—to buy up the works of the Company. Did that, or did it not, point to a mere Bill, asking for a power beneficial to the public to try experiments for the purpose of seeing whether the electric light was a good thing or not, or did it point to the real intention on the part of the Corporation of Liverpool to get before everybody else, to anticipate general legislation, and to obtain by a private Act of Parliament powers which should give them a footing against the Gas Company, which powers, in the first instance, would damage the value of the shares and property of the Company, and also place the promoters, as it undoubtedly would do, in a far better position to negotiate with the Company for the purchase of their undertaking, than if there had been no such legislation? A great amount of criticism might be offered upon the extraordinary words, "places of public resort," including possibly as much as the Town Clerk had to admit those words would extend to, there being hardly anything, in fact, which they might not be empowered to light under that phrase. A shop had been held to be a place of public resort; and if attention had not been called to that, and if they had gone out of the committee-room with those words as they stood, unlimited, it would have been found that they were dealing, in the first place, with the supply of the public lighting; and then, finding that the supply of electric lighting was in their hands, and that they supplied it profitably, they would, without further legislation, have been empowered to intrude themselves into various places of public resort, and so do the Gas Company irreparable injury. That was the argument to be adduced against the Bill. For the purpose for which the Corporation said they required it, it was absolutely unnecessary. If they had wished it, they might have had all their valuable buildings lighted up; they might have had a wire from the top of St. George's Hall to the top of the Picton Reading-Room, or they might have taken it under the street without the slightest danger that any jury would be so absurd as to say that that which was for their benefit was for their disadvantage. The absolute want of necessity for the Bill showed what was its real object, or showed the way in which it might be utilized if it was passed. In conclusion, the learned Counsel said he had tried to impress upon the Committee that the proposed Bill might work the greatest injustice possible, because it was in anticipation of that general legislation which must take place upon the subject, and which he ventured to suggest the Select Committee had intended to recommend; which might possibly be quite inconsistent with the proposed legislation of that day, and which, at all events, could never be applied to the proposed 39th clause, because it could never be applied *ex post facto*, so as to restore the Gas Company to the position they occupied at the present moment, and which they would continue to occupy unless they were prevented from doing so by such legislation as that now proposed.

The committee-room was then cleared. After some time the Counsel and parties were called in.

The Chairman said: We have decided to pass the preamble, with amendments; but the object of the Committee in passing the preamble is to enable the Corporation of Liverpool to make an experiment in lighting by electricity, and the Committee are of opinion that the clauses of the Bill should be scrutinized with the view of effecting that object, and that the preamble should be amended accordingly.

After some conversation, in the course of which Mr. Aspinall intimated that the opposition would be renewed in the House of Lords, the Committee adjourned till Thursday, July 4, to enable the clauses to be amended in accordance with the decision announced by the Chairman.

Thursday, July 4.

Mr. Aspinall said he understood that on Monday the Committee had decided to pass the preamble of the Bill, provided certain clauses were added. The memorandum furnished to him was to the effect that the preamble had passed, and that the Committee had decided to enable the Corporation to make an experiment in respect to the electric light. The Bill, however, so far from being amended in accordance with that suggestion, had been made infinitely more objectionable. The amendments, in point of fact, were the merest evasion, and, considering this circumstance, he certainly would appeal to the Committee to say that the preamble of the Bill was not proved.

An adjournment then took place in order to consult as to the clauses. Subsequently,

Mr. Pope said he ventured to think that the alterations which had been made had brought them entirely within the decision of the Committee, who had decided to pass the preamble with amendments. The object of the Committee in passing the preamble was solely to enable the Corporation of Liverpool to make an experiment; and he gathered that that decision was illustrated, if not expanded, by the Committee saying that what they desired to avoid was giving the Corporation power to enter into a commercial undertaking and competition with the Gas Company, but to let them experiment in electric lighting without making a profit by the transaction. The object of the Corporation would not be to make a profit out of the ratepayers, or for their benefit, but they desired that the clauses of the Bill to enable them to carry out that experiment should be such as to make it worthy of a trial. The mere fixing of an electric light on the top of a post was not an experiment; and the question was, how far it could be economically used for the purpose of public lighting, and that experiment, he understood, would be tried by the Corporation. If the Committee would refer to the preamble, they would find that the second section in it was as follows:—"And whereas it was expedient that the Corporation should be authorized to manufacture, or provide, or supply light by means of electricity in the borough;" but they proposed to amend it as follows:—"Whereas it is expedient that the Corporation, for the purpose of experiment, be authorized, for a limited period, to manufacture, provide, and supply light for the purposes in this Act mentioned, but not for the purpose of private lighting by means of electricity." The words "for a limited period" were inserted for the purpose of experiment; they would not be entitled to enter into a permanent arrangement, but they must have a limited period to enable them fairly to carry out the experiments that were necessary. Instead of saying "public and private purposes," they said "for the purposes in this Act mentioned." In the preamble they had inserted the words "five years from the 1st of September, 1879," as being the limited period for the purpose of lighting the streets and places of public resort. There was a clause devised exempting the Corporation from any general Act that might be passed within the five years; so that, in the event of Parliament passing any general Act, then the saving clause would prevent this Act from overriding such general enactment. They also proposed to insert an interpretation clause as to the word "street," which should be the same as that defined in the Public Health Act; and as to the words "public resort," they would refer to—first, any premises belonging to or used by the Corporation, whether as a municipal or sanitary authority; secondly, any of the premises connected with the Docks and Harbour Board; thirdly, any railway station, public slaughter-house, or public theatre; and, fourthly, any other place of public resort which the Local Board from time to time approved.

The Chairman said that in any of those cases there was to be no profit derived.

Mr. Pope replied that there would be none whatever. Then there was a clause providing that no greater payment should be received by the Corporation in respect to the supply of light under this Act, in any place of public resort, than the actual cost of the same, such cost to be determined by the place of public resort.

The Chairman: These places, I presume, are now lighted with gas?

Mr. Pope said they were. If the Gas Company had no vested interest in lighting the public streets, no doubt the mere trial of the experiment on a large scale must, of necessity, interfere with it. What they had done, however, was *bonâ fide*, and had brought the powers within the limitations they might reasonably ask for.

The Chairman: The difficulty at once arises, that this Corporation have no powers of lighting by gas; therefore, if we give them lighting powers and lighting jurisdiction over the area already provided with gas, you are *pro tanto* going over the ground already covered.

Mr. Pope said that the Gas Company had no exclusive right to supply light. They merely sold to the Corporation at a certain price agreed upon. If the Corporation chose to say to the Gas Company that they would not take another foot of their gas, Liverpool might be in darkness, but the Gas Company would have nothing to do with it. All their obligation was to supply gas and to light the public streets when called upon by the Corporation; and they had no vested rights in the street-lamps. The Corporation could give the Gas Company six months notice to terminate their contract with them, and they might put the electric light into every one of their street-lamps, provided they had the power. They did not by this Act in any way restrict or limit the rights of the Gas Company under the contract. They would terminate the existing contract, and not renew it. The object was to get a tentative Act, and they wanted to carry it out economically. It would be lamentable, he contended, if there were any legislative restrictions which were calculated to interfere with the development of the system of the electric light.

Mr. Aspinall briefly replied, and said that the Committee had already heard his objections to the preamble of the Bill being proved.

The committee-room was then cleared. On the public being re-admitted,

The Chairman said: The Committee have decided to pass the preamble, as amended by the promoters.

The clauses were then gone through, and the Bill, as amended, was ordered to be reported to the House.

Legal Intelligence.

SOUTH SHIELDS COUNTY COURT.—Thursday, July 10.

(*Before Mr.* E. J. Meynell, *Judge.*)

SOUTH SHIELDS CORPORATION *v.* SOUTH SHIELDS GAS COMPANY.

This was an action relating to a claim preferred by the South Shields Corporation against the Gas Company for costs incurred in repairing and reinstating the surface of certain roads along the course of the Company's new gas-mains, in consequence of the delay and omission of the Company to properly reinstate and make good such roads after the completion of their main-laying operations. The costs in question amounted to £20 15s. 11d., and included £3 15s. for the use of a steam-roller.

The Town Clerk (Mr. M. J. Moore) appeared for the Corporation; Mr. R. Purvis represented the Gas Company.

The Town Clerk, in stating the case for the Corporation, said this was an action brought by the Mayor, Corporation, and Burgesses of the borough of South Shields, in whom the roads of the borough were vested, to recover from the defendants, the South Shields Gas Company, a sum of £20 15s. 11d., moneys expended by the plaintiffs in repairing Ocean Road and Fowler Street, in South Shields, after the defendants had opened them for the purpose of laying down a gas-main. Shortly prior to such opening by the defendants, the roadway had been put into a state of thorough repair.

Mr. Purvis said counsel had been instructed to appear on behalf of the defendants, but had not arrived, and, having consulted with the Directors of the Company, he asked for an adjournment of the case, undertaking to pay the costs.

The Town Clerk objected to an adjournment. Mr. Purvis was perfectly qualified to go on with the case in the absence of counsel.

Mr. Purvis said the learned counsel who had been instructed to appear for the Company had some important papers in his possession, and his clients preferred that he should be present. This was an important matter, and not merely a denial of the debt, for the Company had a *bonâ fide* defence.

The Town Clerk said he was under the impression that there was not a scintilla of defence, and that the money ought to have been paid.

After some further conversation, the Town Clerk agreed that the case should stand over until the next court (Aug. 14), without costs.

The case was accordingly adjourned.

Sewage Scheme for Llandaff.—The Cardiff Rural Sanitary Authority having applied to the Local Government Board for leave to borrow £3000 for works of sewage and sewage disposal for Llandaff, a Local Government inquiry into the matter was recently held at Cardiff, before Major Tulloch. It was explained that the object of the scheme, to which no opposition was offered, was the circulation of the sewage by means of the rainfall. The amount of the estimate for the works was £2312, and £3000 was asked for, as the Authority wished to avoid the necessity for a further application for money. The inhabitants depended for their water supply upon wells which the medical officer had pronounced to be impure, and it was thought that if the sewage was disposed of the wells would, in time, purify themselves, thus preventing all outbreak of disease. Major Tulloch promised to report to the Local Government Board accordingly.

Miscellaneous News.

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from page* 67.)

Mr. J. A. G. Ross (Newcastle-on-Tyne*) read a paper on

THE APPLICATION OF HYDRAULIC MACHINERY TO GAS-WORKS.

It occurred to me, when requested by your President, some short time ago, to write a paper for this meeting, that, as Newcastle-on-Tyne was the birthplace of the modern development of water-pressure machinery, and as there are so many notable examples of its application in this immediate neighbourhood, some of which the members of the Association will have an opportunity of visiting during their excursions, a paper on hydraulic machinery, as applied to gas-works, would not be unacceptable to the British Association of Gas Managers.

It will be quite unnecessary to enter into a history of the subject generally, or to go back to the labours of Bramah. It should, however, be stated that the present hydraulic system owes its origin and development to Sir William George Armstrong, C.B. The author remembers,

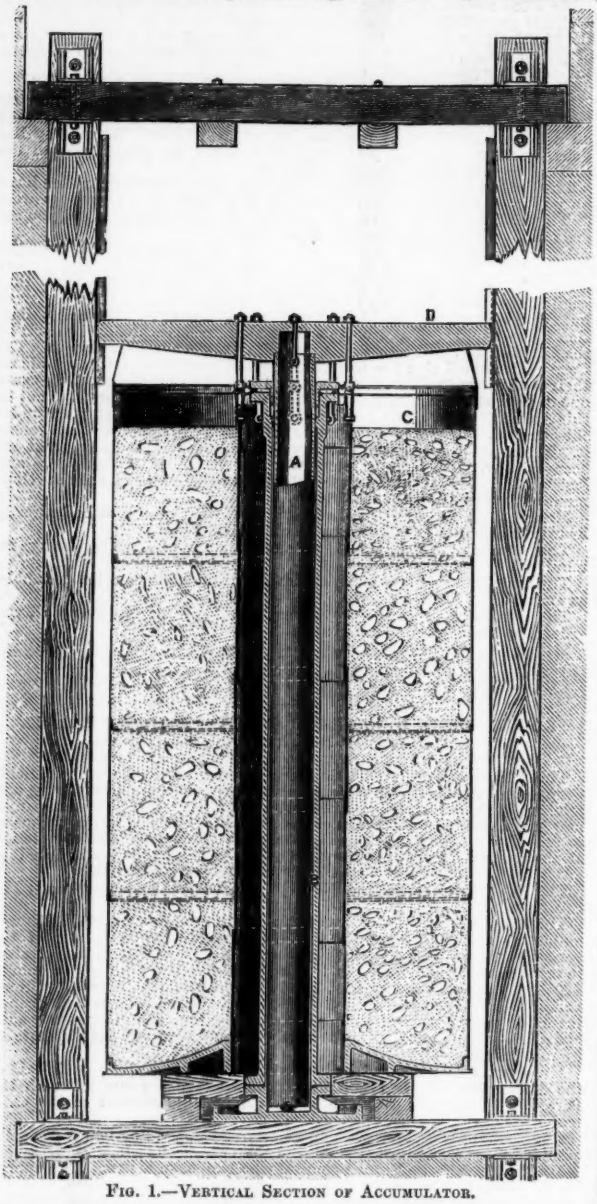


Fig. 1.—Vertical Section of Accumulator.

a little over 20 years ago, when an apprentice at the Elswick Works, a rotatory water-pressure engine, which was made in the year 1839. This was worked from the Water Company's main, and gave a very high efficiency, but was never, he believes, applied to active work. This was followed in the year 1846 by a 5-ton crane, erected on Newcastle Quay, for shipping and unshipping goods. This machine also was worked from the Water Company's mains, and showed very great efficiency, and has remained in operation until recently, being now replaced by a more powerful crane.

In some cases, where water pressure was not available from town mains, the water was pumped by a steam-engine to a reservoir on the top of a high tower, as at Grimsby and other places, to obtain the necessary pressure. These methods of obtaining hydraulic pressure did very well in certain cases, but were not generally applicable. They were succeeded by a contrivance called the "Accumulator," which consists of a plunger or ram working in a vertical cylinder, and loaded with a sufficient amount of weight to give the requisite pressure by having the water forced into the cylinder by manual labour or steam power.

* To prevent misapprehension, we have been asked to state that Mr. Ross has no connection with any firm in the North. He was formerly with Sir W. G. Armstrong and Co., but is now an independent Consulting Engineer.—Ed. J. G. L.

The invention of the accumulator may fairly be looked upon as the starting-point for the development of modern water-pressure machinery, inasmuch as by it water of very high pressures can be stored up in any situation, and may be distributed to various machines at great distances apart by comparatively small pipes. (The usual pressure being 700 lbs. to 1000 lbs. per square inch.) But in certain notable cases this pressure has been much exceeded; as, for example, in the chain and anchor testing machinery erected at Sunderland for the British Government, by Messrs. J. Abbot and Co., of Gateshead, the ordinary daily working pressure is 2000 lbs. per square inch. The accumulator thus serves to produce not only an artificial head of water, but also stores up the amount of pressure water not required at the time by rising to the top of its stroke; by which action the supply of steam is cut off, and the speed of the pumping-engine reduced.

Fig. 1 is a vertical section through an ordinary accumulator. A is the plunger; B, the cylinder; C, the weight and weight-case attached to the plunger by the crosshead, D; while E is the pipe for the admission and exit of the pressure water.

Figs. 2 and 3 are the plan and elevation (enlarged) of a hydraulic pumping arrangement to give off 25 to 30-horse power in the pressure of water. A is the boiler; B, the steam-engine pumping; C, the water accumulator; D, the tank from which the suction water is drawn, and to which it may be returned again by return pipes from the machines; E, the pressure delivery from the steam pumping engine to the accumulator; F, the pressure-pipe leading from the accumulator for the purpose of distributing power to the different machines.

Within the last few years, the application of the hydraulic system has been greatly extended, and is capable of still further increase. Within a short distance of this lecture-room, the author has seen a hydraulic machine exercising the force of a few pounds in driving a sewing-machine with great regularity. In another case, the Tyne Swing Bridge, weighing about 1600 tons, is sustained and worked with great precision by the hydraulic system. The members will have an opportunity of judging of the efficiency of the system in this case, as well as at the works of Sir W. G. Armstrong and Co.; the 100-ton sheers at Elswick, in which a suspended cylinder takes the whole weight direct without the intervention of chains; the 80-ton crane on Newcastle Quay; the grain warehouses; and the Forth Banks Goods Station of the North-Eastern Railway.

Hydraulic machinery is especially suitable where the work to be done is intermittent, as in cranes, hoists, capstans, lifting purifier-covers in gas-works, &c.; as it admits of the use of one small steam or gas engine for generating the pressure by charging the accumulator, which may be placed on any part of the works distant from the machines; the power or capacity of each machine being determined by the capacity of the accumulator only, and the frequency of the operations would determine the power of the steam-engine. When there are several machines working, the accumulator should be of such a capacity as to be able to supply in one stroke the maximum number of machines likely to require a charge at one time. Thus an unlimited number of intermittent machines may be worked from the same steam-engine and accumulator, and being at great distances from each other, if required, still retaining their efficiency; for the loss of pressure in the pipes is very small, and varies inversely as the fifth power of the diameter.

Mr. Robinson, in a paper read before the Institution of Civil Engineers, says that gauges have been placed on a main composed of 4-inch, 3-inch, and 2-inch pipes, in the Great Western Railway Yard at Paddington, from 1000 to 1600 yards apart, and the pressure has been found to be practically the same during the working of the machines in the usual way, being slightly higher at the accumulator. At Swansea, whenever the pressure in the main has been tried, it has been found to be uniform.

The friction on rams, direct-acting, with cupped leathers, has been determined very carefully by Mr. Hick, of Bolton, who has shown that for a 10-inch diameter of ram the loss is only 0·4 per cent.; for a 20-inch diameter of ram, 0·2 per cent., and so on; the percentage of loss being inversely as the diameter, for whilst the power varies as the square of the diameter, the friction varies as the diameter. For hemp packing the friction is greater, being 2 per cent. in accumulators 17 inches diameter at 700 lbs. per square inch. In ordinary crane work, the Elswick firm find the following to be an ample allowance for friction:—

Direct-acting ram				93	per cent.	efficiency.
2 to 1	multiplying	power of	sheaves .	80	,,	,,
4 ,, 1	,,	,,	,,	76	,,	,,
6 ,, 1	,,	,,	,,	72	,,	,,
8 ,, 1	,,	,,	,,	67	,,	,,
10 ,, 1	,,	,,	,,	63	,,	,,
12 ,, 1	,,	,,	,,	59	,,	,,
14 ,, 1	,,	,,	,,	54	,,	,,
16 ,, 1	,,	,,	,,	50	,,	,,

A smaller diameter of pin, a larger diameter of sheave, or a smaller chain, will give a greater efficiency.

The compounded efficiency of the steam-engine and accumulator—that is, from the indicator diagram of the steam cylinder to the delivery of water from the accumulator—is from 75 to 82 per cent. Whenever steam-pipes have to be carried any distance, there is not only a great loss of pressure, by the condensation of the steam and the leakage at the joints, but the condensed steam must be disposed of, and great difficulty is experienced in keeping the joints tight, and in a comparatively short time it is necessary to insert fresh india-rubber in the joints. The joints of hydraulic pipes will, on the contrary, remain intact for years, subject to the highest pressures, and if a leak does occur, the loss is much less than by the leakage of steam, and can be more easily remedied. It can be shown that at the ordinary working pressures for air and water—viz., 40 to 50 lbs. per square inch for the former, and 700 lbs. per square inch for the latter—the loss of power in transmitting the former is 20 to 30 times that of the latter.

It has often been urged against hydraulic pressure, the danger of breakage from frost. However, if the pipes are laid from 2 ft. to 2 ft. 6 in. below the ground, there is not the slightest risk of the action of frost reaching them. The machine itself may be protected by a gas-jet, or if in exposed situations, the water may be run out by a drain-cock. About 5 per cent. of methylated spirit introduced in the water has been found to prevent it freezing.

The celerity with which ships or barges can be unloaded with hydraulic cranes is marvellous. One crane, lifting at the rate of about 10 feet per second, will perform as much as 1000 to 3000 foot tons per hour; and whilst the load is being moved at such a high speed, the machinery itself is moving quite slowly—viz., one stroke of the ram or plunger at one entire lift of the load. Where there is much dust flying about, especially coke dust, which is of a very hard and gritty nature, this is a matter of great importance, as the axles and shafts of quickly-rotating gas or steam engines are rapidly worn away, and require great and continual attention and repairs.

The simplicity of hydraulic machinery renders it capable of being worked by unskilled labourers or boys, and the fewness and simplicity of the moving parts, together with their slow motions, reduces the amount

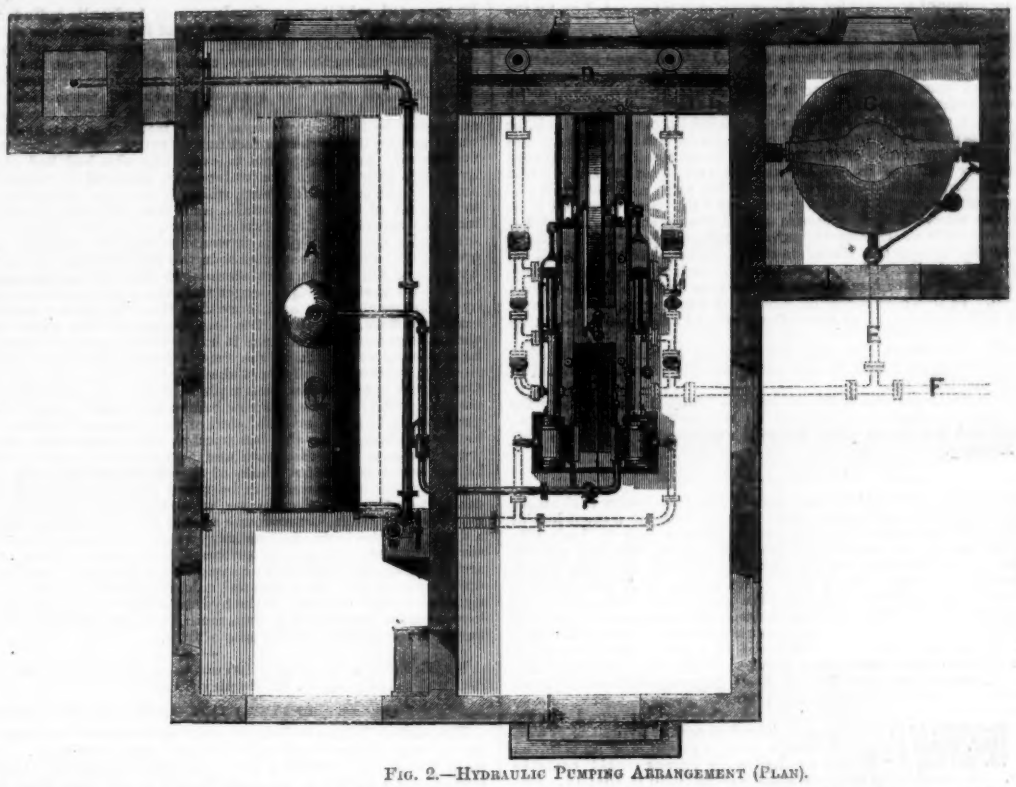


Fig. 2.—Hydraulic Pumping Arrangement (Plan).

of repairs to a minimum. In a hydraulic engine at a lead mine in Northumberland, the engine-man never saw the engine for years; he was simply instructed in the use of the handles, the engineer in charge of the works examining the machinery occasionally. Another advantage of hydraulic machinery is that a machine which has been out of action for years will be ready for use at a moment's notice by merely turning on the stop-valve, there being no complication in the machinery to attend to.

The equality and constancy of hydraulic pressure renders it particularly suitable for gas-works machinery, requiring, as in the case of the exhausters, great regularity and certainty of action. Moreover, water, considered practically, is, at moderate pressures such as are proposed to be used, incompressible. This gives it the power of great definiteness in working, and affords an instantaneous means of checking and controlling its action and speed.

The incompressibility of water was a very serious obstacle to the introduction of water-pressure machinery in the first instance, as the inertia of a moving mass suddenly stopped, and without an elastic cushion to take up the additional induced pressure, caused innumerable breakages of cylinders, &c.; but this difficulty was most perfectly overcome by the now well-known check and relief valves invented by Sir W. G. Armstrong, which prevent any considerable rise above the accumulator pressure in any part of the system.

For hydraulic machinery, the cost, under ordinary circumstances, has been found in various dockyards and warehouses to vary from 0·7d. to 1·89d. per 100 foot tons delivered into the mains, giving an average of 1·26d. per 100 foot tons. The cost of labour at the cranes being 0·46d. per 100 foot tons, in all 1·72d. per 100 foot tons; whereas for manual labour the cost is from six to nine times this amount. According to experiments in gas-works carbonizing 50,000 tons of coal per year, it was found that in coal-discharging, manual labour cost from 5d. to 8d. per ton; hydraulic power, 1½d. to 2d. per ton; steam power, 2½d. to 3d. per ton.

I propose, then, to perform all the mechanical operations in gas-works by the aid of hydraulic power, as being more manageable, more reliable, costing less, and requiring less attention than any other method of transmitting and applying power. The power may be generated in the first instance by a steam-engine, as shown in Figs. 2 and 3, or by a gas-engine, when, of course, the boilers would not be required. I propose for a vertical exhauster, a vertical, direct-acting hydraulic cylinder, placed immediately above a vertical rectilinear exhauster—say 3 feet diameter and 8½ feet stroke; this would give about 80,000 cubic feet of gas per hour at 12 strokes per minute. As the strains would be all self-contained, no foundations would be required, except merely for carrying the weight of parts The entire horizontal space occupied being about 3 ft. 6 in. square.

The hydraulic cylinder could be arranged to have a single-acting ram for the up-stroke; the return action being accomplished by a counter-weight, for simplicity. The same result could be attained by a piston and piston-rod in the hydraulic cylinder. This machine could be set to work at from about 1 stroke in five minutes up to about 12 strokes per minute. The slightest action of the gas governor would produce an immediate action on the speed of this machine, at whatever portion of the stroke it might be, and by the aid of a supplementary valve it would be impossible to stop at any part of the stroke having no dead centres; the delivery of

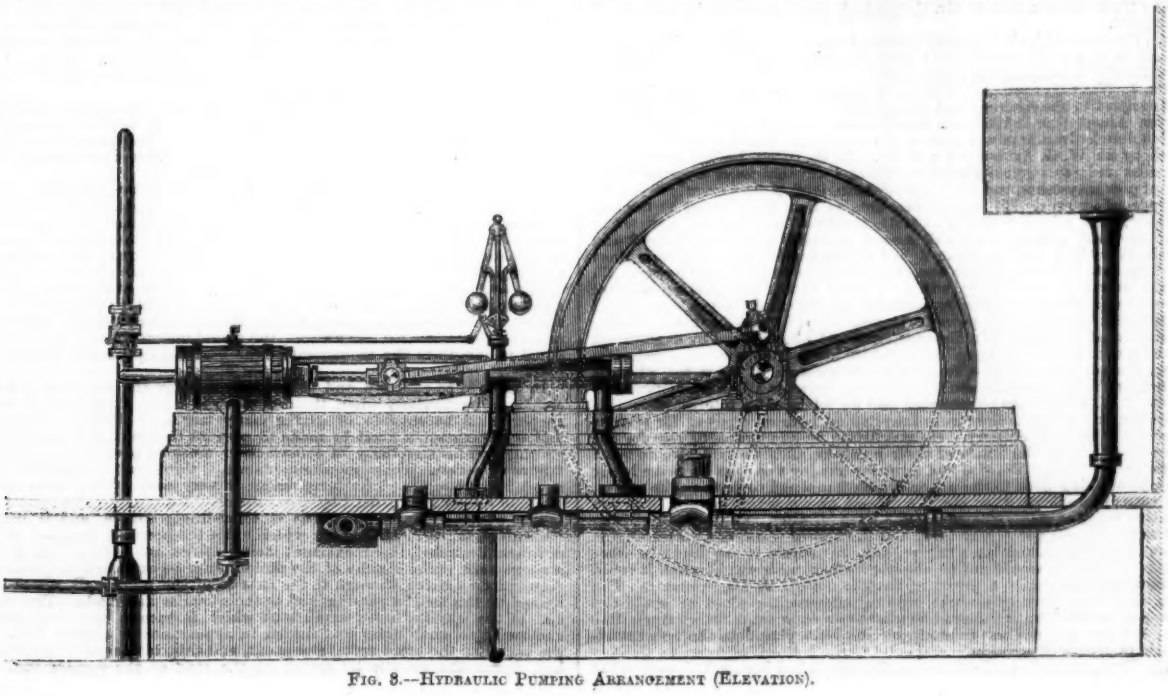


Fig. 3.—Hydraulic Pumping Arrangement (Elevation).

the gas being constant and regular, and varying only when acted on by the governor.

In the ordinary vertical exhauster, worked from a crank-shaft, the delivery of gas during a stroke varies from 0 to 1; for two cylinders at right angles the delivery varies from 1 to 1·414. Assume the pressure of the gas delivered from the exhauster to be 20 inches of water, and on the side next the hydraulic main to be, say, 4 inches of vacuum, equal to a total of 24 inches of water, which is equal to 0·868 lb. per square inch, or say 1 lb.; then, according to Boyle's law of pressures, the full delivery and pressure of gas after the turn of the stroke will be attained when the piston has travelled over 1-16th of its stroke, which for an 8-feet stroke, at 3 feet per second velocity, will be 1-6th of a second. Or take a 4-feet stroke at 15 strokes per minute, equal to 2 feet per second; the time occupied from the turn of the stroke to full pressure and delivery will be 1-8th of a second; whereas with a reciprocating exhauster, driven from a crank-shaft, the time from the turn of the stroke to the maximum delivery would be one second, and similarly for a rotatory exhauster. For a rotatory exhauster, a three-cylinder ram engine (rotatory) as employed for capstans might be used. In this case a regular motion of the engine would result in a varying delivery during one revolution, owing to the principle of this exhauster.

Where mechanical retort charging and drawing machines are used, a similar hydraulic engine might be applied by driving the endless cord at the end of the retort-house.

[Appended to the paper was a list of certain hydraulic machinery for gas-works, which has been manufactured by Messrs. John Abbot and Co., of Gateshead, and the detail plans for which were exhibited on the wall during the meeting.]

Discussion.

Mr. F. Colyer (London) said he understood Mr. Ross to say that steam could not be carried through a long length of pipe without a great loss in condensation; but having had considerable experience both in hydraulic and steam machinery, he could not agree with him. He had carried steam 500 feet in one direction and 400 feet in another on the same wharf, with, he thought he might say, a loss of from 1 lb. to 1½ lbs. pressure per square inch. The difficulty of keeping the joints tight was nothing like so great as represented; with proper expansion joints, and condenser boxes to take off the condensed water, he never experienced the difficulties mentioned. He spoke with some diffidence in a town like Newcastle, where there were so many gentlemen present connected with hydraulic machinery. It was not his intention to at all disparage hydraulic power in any case where it might be applicable; but he thought it was only so in large gas-works. Steam power was far cheaper for small works, whether in gas-works, or in other places. The first cost of hydraulic power, roughly speaking, would be nearly double that of steam, and he believed the cost of 7d. per ton for lifting by hydraulic cranes would come to nearer 1s. 8d. He should like to know what was included in that 7d. Did it include interest on money, wear and tear, and all expenses, and also a sinking-fund for renewal? As to the suggestion of working exhausters by hydraulic power, he thought it would result in utter failure. Amongst the experiments which were tried, they were indebted to Mr. Hick, of Bolton, for his experiments on the friction of hydraulic collars, from which it appeared that it varied with the pressure. With regard to the cost, they were informed that it was 2d. per ton for water, 3d. for steam, and 5d. to 8d. for hand power. He was desirous of knowing what expenses were included in that, for he should be rather inclined to reverse the figures. From all the experience he had had, water cost more than steam, if they took all the expenses into account. Then the speed of the crane was put at 6 feet per second, or 360 feet per minute, which he ventured to say would be a most dangerous speed to work at. In unloading coals, which was one of the most general things in gas-works, 200 feet per minute was about the maximum speed for safety. Hydraulic machinery was originally worked on the North-Eastern Railway by Sir William Armstrong, and he thought that an air-vessel could be used for small works with great advantage, where it would be impossible to have an accumulator on account of the first cost. The only difficulty was keeping it charged with air. The other details were those with which they were all acquainted. The system of raising purifiers by a modification of a ram lifting at the centre was very simple, except that, in his belief, it would be found to unduly strain the crown of the purifiers. About the neatest arrangement he had seen for a hydraulic lift was one made by Messrs. Tangye Brothers and Holman, with an ingenious arrangement for carrying the water pressure by a line of pipes with a universal joint adjustable as the traveller was moved.

The President asked if Mr. Colyer had any experience in the use of that joint.

Mr. Colyer said he had not any personal experience of it, but it appeared to him to be a very nice and neat arrangement, and he believed there was no difficulty in keeping the joints tight.

Mr. J. Watt Sandeman said he could confirm what Mr. Ross had stated with regard to the economy and advantages attending the use of hydraulic power. About nine or ten years since he introduced at Greenock Harbour a complete hydraulic power system of cranes and hoists, which was supplied by Sir W. G. Armstrong and Co. At that time he had occasion to consider and report on the relative cost and advantages of hydraulic and steam power systems, and the conclusions arrived at were greatly in favour of hydraulic power. He should mention, as had been stated by the last speaker, that where power was only required for a limited number of machines, say one or two small cranes, probably steam would be found the least costly; but wherever it had to be supplied to several machines working intermittently, there was great economy in hydraulic power. No doubt now that machinery was to a great extent superseding manual labour in gas-works, greater opportunity was afforded for the economical application of hydraulic power. It also offered great facilities for the transmission of energy to a distance, as it had been proved by experiment that even up to two or three miles (when moving at the usual velocity) there was no appreciable difference in the pressure of the water, whereas steam, without great loss, could only be conveyed to a limited distance.

Mr. P. H. Wilkinson (Harrogate) said he felt greatly interested in this question, inasmuch as they were introducing hydraulic power for various portions of their machinery. He was fitting up one hydraulic ram for the purpose of lifting the whole of their purifiers, and it would also do some other work. They likewise had a lift for raising the coke from the lower regions or firing floor to the upper, which happened to be the coke stores. He wished to ask whether Mr. Ross could give any information as to the relative value of water when delivered by gravitation, at a pressure of from 100 to 120 pounds per square inch, and the cost of working a steam-engine so as to get the accumulator to give, say, 700 pounds if required; in other words, whether it would not be cheaper to work with water, when it could be obtained with such a pressure, than to set up an accumulator. The ram they were putting up was only in progress, therefore he could not give any results; but he should be glad to do so at some future time. The coke lift was also not yet in work, having been placed in the new retort-house in course of erection.

Mr. Ross, in reply to the first question which had been asked, as to what he proposed, said it was a simple ram or hydraulic cylinder placed at the top of the exhauster. The regularity of the motion was something which could not be equalled by steam. It was possible to act by it on the exhaust-pipe and on the pressure, and regulate it with the greatest nicety. That had been accomplished both in air and water pumping machinery, and the small space the apparatus occupied recommended it at once. With regard to the loss by using steam, which, Mr. Colyer admitted amounted to 1½ lbs. of pressure in 500 feet, when one spoke of conveying water power, it was not by feet but by miles. Even then the loss was infinitesimal. It was apparent to every one who had had experience with hydraulic power, that the water-pipes required no attention; they lay buried in the ground for years, which was a great advantage. With regard to the cost of steam, hydraulic, and manual power, the figures he gave included everything: interest on capital as well as labour. Of course, if they had a very small plant, it would be slightly different. Any engineer present who had had experience in the use of steam and hydraulic power would bear him out in the statement that the cost of the latter was much below that of steam. The larger the plant the greater was the economy of hydraulic machinery; and, more than that, the greater distances apart the machines were, as well as the less frequency with which the whole was used, the greater convenience it had. With regard to the speed of lifting, he had seen cranes lift at the rate of from 8 to 10 feet per second, quite steadily, without the slightest chance of accident. The best answer to Mr. Colyer was the fact that steam plant, in the case of docks, railway goods stations, and gas-works, was now being superseded by hydraulic machinery, the most recent case he had heard of being that of Beckton. In reference to the question put by the last speaker about the relative efficiency of low water pressure from the main and accumulator pressure, that could only be answered when the whole of the circumstances were stated. There was the price of the water to be taken into account, and the amount of draught on the pipe. Sometimes, when they had a pressure of 120 lbs. indicated by the gauge, it was found that it was not regular; they might have a draught to the town, pulling away a very large proportion of the low pressure; whereas, with a high pressure, they were working under a system, and could apply it generally; consequently, they were not dependent on the town main at all. As a general rule, he should certainly say, put down hydraulic plant; though, if the hydraulic machinery were worked through low-pressure water from a town main, it would not be so reliable, as they knew, unfortunately, in the case of fires.

Mr. E. Price (Hampton Wick) not being present, the following paper by him was read by Mr. F. W. Hartley (London):—

THE LAMPLIGHTER'S TELL-TALE AND TIME-KEEPER.

The matter I have to bring to your notice is an invention of my own to serve what I have found to be a most essential purpose. It is an instrument which I have found a most effective lamplighter's tell-tale or time-keeper, and I hope you will consider that it has some merit as a useful aid in the important matter of regulating the service of public lights. The necessity of having a proper check on the lamplighters, who in some works are very numerous, is well known by you all, and the difficulty of obtaining this check has been experienced by not a few; indeed, in my own case, this necessity has been "the mother of invention."

I was convinced that my Company were suffering a heavy loss by needless consumption of gas through the want of punctuality on the part of lamp lighters and extinguishers; in fact, acquaintances have at times remarked to me, "How late your lights were burning this morning;" and, as you may reasonably suppose, I concluded that the lights were burning later on many mornings of which I obtained no information; for, in the summer time, the lights are supposed to be extinguished long before people are stirring, and the men considered they were safe in indulging themselves in bed an hour or two after they should have been at their work. Of course they denied everything in the emphatic style men ever assume when they have themselves as well as another to convince; but it was plain that a quantity of gas was being wasted, and a serious leak in the purse of my Company had to be stopped.

I tried in several ways to secure myself against this loss and annoyance, but failed. I put the men "on their honour," and made them enter their time, and "took notice." The entries were very satisfactory indeed, regularly made, and showing that the reformation of the men was complete; but observation proved that a lamplighter on his honour is a "delusion," and his entries a "snare." Then I entrusted to a supposedly trustworthy foreman night-stoker the duty of making these entries, and rested on my laurels, thinking, "I've done the rascals now." But no; this trouble evidently had for its motto "*Resurgam*." This foreman night-stoker had a laudable abhorrence of "putting off till to-morrow what may be done to-day," and perhaps, too, had some sympathy with the lamplighters, so finding that suspicion had been lulled, he made the "entries" for a whole week in advance, and defended his action by saying, "I am sure the men will keep their time, Sir." So this nocturnal son of Vulcan took his place among the other failures.

The memorable words of the knight of the awl came to my mind, and something of that *esprit de corps* inspired me; so I came to a conclusion with which I am sure you will agree, that "There's nothing like"—mechanism. This brought about the simple little contrivance I will describe, and the whole trouble has disappeared.

The instrument is, in the first place, a clock *minus* hands, and has a cardboard disc divided into 24 hours. This disc is made to revolve by the clockwork, and on this card one man, or a number of men, can mark their time with infallible accuracy and distinctness, by the simplest possible movement, in which there is no variation, however great the number of men registering may be. The vertical sliding bar which is in front of the disc, and about an inch and a half from it, has a tube at its lower end at a right angle with itself, in which is a piece of lead pencil pushed by a spring, so that its point presses lightly against the cardboard. Naturally, when the bar is moved downwards, the pencil makes a stroke on the card equal in length to the movement of the bar, and in this way the time is marked.

In order to be effective, and to properly register the time kept by the *employés*, particularly when their number is great, a mechanical time-keeper must be capable of giving many marks of distinct difference, and an arrangement must be made to prevent the serving of one man by another, while simplicity of construction must be preserved to prevent failure of action. These requirements are, I think, met perfectly by this small instrument, and its form makes it very easy to fix in an office, while of necessity it is used by men outside.

The working of the apparatus is exceedingly simple, and it has no delicate parts. The sliding-bar which holds the pencil is made to give a downward stroke, the movement being given by a rack and pinion arrangement. The spindle of the pinion must be extended to the length required for passing through to the outside of the office wall, where it is turned by the men in passing, and so their marks are made. The outer end of the spindle has a small stud which is turned by a key, and is enclosed by a small brass box, similar in appearance to a brass lock. In the barrel of the key a spiral slot is cut, and this, in the pushing in of the key, turns the spindle by acting on the stud at the spindle end. Of

course, the longer the spiral slot, and the further the key is pushed in, the longer the stroke of the sliding-bar will be; and this makes the distinction of marks. One man has a long key, and another a short one, and the brass box is fitted with a spring catch which acts on a small ratchet-cut on the key, and so the key is held before it can move the spindle at all, and cannot be withdrawn until it has given the full stroke for which it is constructed, and it must then be turned slightly, and taken out from another opening. This arrangement makes it impossible for one key to do the work of another. The only difference between a single and a many keyed instrument, is in the brass box which encloses the outer end of the spindle. For one key it is shallow, and it increases in depth according to the length of key used.

It may be urged that one man marking at the same time as another may lead to confusion. The only answer I can give is, "They mustn't do so." I think [illegible] that at least five minutes shall elapse between the markings, arranging that the man who has the most distant round starts the earliest, and the cards or discs are sufficiently large to receive the numerous markings without the slightest risk of confusion. These cards are printed for night and day, or for 12 hours only, according to requirements. They are changed daily, and I have a book ruled and divided into heads, in which I enter what has been and what should have been, and this gives me a complete record, which is of considerable value.

The keeping of the time in street lighting is one of those things in which no scientific principle is involved—at least, no principle of the exact sciences; still it is important, for failing in punctuality occasions much vexation always, and often great loss. Though my invention can claim no high place in the record of the advance of the arts and sciences, yet I trust it may be recognized as a useful contrivance, and an appreciable aid in the business department of our profession, and I hope in many others; and if it removes a thorn from the path of any suffering manager, I shall be sufficiently honoured.

Discussion.

The PRESIDENT said Mr. Price had on various occasions favoured them with several ingenious instruments of this kind, and they were much indebted to him. This was doubtless a very useful instrument, and would come into general use.

Mr. D. BRUCE PEEBLES (Edinburgh) was exceedingly pleased to see this beautiful arrangement of a clock tell-tale for the use of gas managers in checking the time at which public lamps were lighted, the more so as he had been giving his attention lately to a little apparatus of a similar kind, which had a different object in view, being a clock in connection with the lamp-post, showing the hour when the gas was lighted.

Mr. R. MITCHELL (Coatbridge) asked where this tell-tale was to be placed.

The PRESIDENT said it was intended to be fixed in the office at the works, where the men started from.

Mr. MITCHELL said although a lamplighter left the works at the proper time, that was no guarantee he would finish his journey faithfully.

Mr. J. CHAPMAN (Harrow) said the great thing was to start well. The character of the men must be ascertained before they started.

Mr. J. MARTIN (Ormskirk) observed that the tell-tale was a very ingenious piece of mechanism, and that it would no doubt answer its purpose admirably, provided that any of the men, designated in the paper "rascals," would not be guilty of omission or commission in relation to the use of the keys. He thought one objection was that a man might lend his key to another to turn the instrument; and therefore it would be no guide whatever to the time of lighting the lamps.

Mr. HARTLEY said he was very glad the objections were so trifling. In the first place, the lamplighter went out in the morning to do his work at a certain time, and he not only had to light the lamps, but to return to the works when he had finished; so that his time occupied was registered, and if he had not lighted the lamps during the time he was out, complaints would very soon arise. As to another man getting the key, the arrangements of the men were such that he who had the longest journey to perform came first, and it was scarcely possible that he could get another to perform his duty by inserting his key; and if he did so, what object would be gained by it? Each man would be subject to instant dismissal for lending another man his key, and certain it was that the man who came five minutes earlier could not make the mark for the man who was due five minutes later without delaying the lighting. He did not think there was any force in such an objection.

Mr. W. FOSTER, M.A., F.C.S., &c., Professor of Chemistry at the Middlesex Hospital, submitted a paper on

THE ESTIMATION OF AMMONIA IN GAS LIQUOR.

The determination of the strength of ammoniacal gas liquor is an operation of such frequent occurrence and importance, that I have thought an account of some experiments which I have been recently making in this direction would be of interest to the Association.

There are two processes in general use by gas engineers. The first and usual method consists in adding dilute sulphuric acid of known strength to a known quantity of the ammoniacal gas liquor, rendered blue by a solution of litmus, and observing the amount of sulphuric acid which is required to cause the blue colour of the litmus to change to pink. This process estimates the amount of ammonia gas and ammonium carbonate in the liquor, but fails completely to notice the fixed salt of ammonia, such as the sulphate. This fixed salt of ammonia is always present in the gas liquor, and may vary very much in amount.

The second process to which I refer consists in distilling a known quantity of the gas liquor with excess of soda or potash in a suitable vessel, collecting the evolved ammonia gas in a second vessel in which an excess of standard sulphuric acid has been previously placed. The amount of the acid neutralized is afterwards ascertained by means of a standard solution of an alkali. This second process is much more accurate than the first, inasmuch as it measures all the ammonia of the gas liquor, whether present as fixed or volatile compounds of ammonia. But more ammonia may be indicated than actually exists in the original gas liquor as ammonium compounds. Bodies of the cyanogen group, and notably cyanides and cyanates, when distilled with soda or potash, are completely decomposed, yielding their nitrogen as ammonia gas. With these exceptions, the distillation process is most accurate.

The process which is the subject of this communication is based on the fact that when ammonium salts in solution are mixed with an alkaline solution of hypobromite of sodium, the nitrogen of the ammonium compounds is liberated in the gaseous state. As the solution employed is strongly alkaline, in consequence of the presence of a relatively large quantity of caustic soda, the fixed salt of ammonia, such as the sulphate, is decomposed by the free alkali at ordinary temperatures, furnishing ammonia gas in solution in addition to that originally present in the gas liquor. This ammonia gas (NH_3) in the presence of the hypobromite is decomposed, producing nitrogen gas, bromide of sodium, and water—

$$2\,NH_3 + 3\,Na\,Br\,O = N_2 + 3\,Na\,Br + 3\,H_2O$$

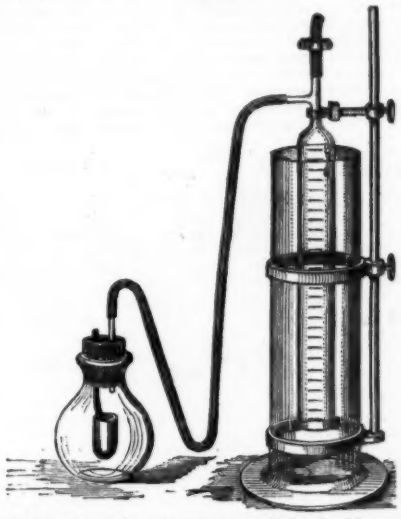
The decomposition takes place immediately at ordinary temperatures, and is complete in two or three minutes. From the volume of gaseous nitrogen obtained, it is easy to calculate the quantity of ammonia originally present in the gas liquor. The nitrogen present in the liquor in the form of cyanides, cyanates, and the like, is not evolved under the circumstances. The process is carried out in the following manner:—

A solution of caustic soda is made by dissolving four ounces of solid caustic soda in water, and adding more water until the total volume is ten fluid ounces. To these ten fluid ounces of strong caustic soda solution one ounce of bromine is added, and the mixture agitated. It then consists of hypobromite of sodium, bromide of sodium, and a considerable quantity of unaltered caustic soda. The change brought about by the addition of the bromine is represented by the equation—

$$2\,Na\,HO + Br_2 = Na\,Br\,O + Na\,Br + H_2O$$

The important substance is the hypobromite of sodium (Na Br O). The solution loses this compound by long keeping. It is therefore advisable not to prepare more of the hypobromite solution than is sufficient to last for a few days. There is no inconvenience in preparing it as required if a stock of the strong soda solution be kept at hand. Small quantities of this are taken, and the proportionate quantity of bromine is added.

For the determination of the ammonia, an apparatus similar to that represented in the accompanying engraving is employed. It consists of a small flask of about three ounces capacity, having a well-fitting india-rubber plug with two perforations. A small test-tube is attached to a piece of glass rod, which passes tightly through one of the holes, thus serving to suspend the test-tube from the lower surface of the rubber plug. A piece of glass tubing passes through the other hole in the india-rubber plug in the other direction, and is connected with a piece of india-rubber tubing, which in turn is attached to the upper extremity of a graduated vessel intended for receiving and measuring the nitrogen gas evolved during an experiment. The upper extremity of the measuring vessel has a T-shape, the limb at right angles serving for the attachment of the india-rubber tube already mentioned, whilst the extreme limb serves to communicate between the interior of the measuring vessel and the atmosphere. This limb is fitted with a piece of india-rubber tubing, which is clamped during an experiment. The measuring-tube is immersed in a glass vessel containing water, and is arranged to slide up and down a metallic rod, and can be fixed at any point along the rod by means of a suitable clamp. The metallic rod is permanently attached to the glass reservoir containing the water.



To make an experiment, an excess of the freshly prepared hypobromite solution is placed in the flask, and a measured quantity of the gas liquor is placed in the small test-tube suspended from the india-rubber plug. The plug is then inserted in the flask, the two liquids being kept quite apart. The outlet at the top of the gas-measuring tube is now opened, and the tube raised or lowered until its zero line coincides with the level of the water, which, of course, is the same both on the inside and the outside. The whole apparatus is then allowed to stand for a few minutes, so that it and the air it contains may assume the temperature of the room. When this is the case, the outlet is tightly clamped. To make sure that the apparatus does not leak, it is as well to raise the measuring-tube 2 or 3 inches, clamp it at that level, and leave it in that condition for a couple of minutes. On lowering the measuring-tube so as to re-adjust the level of the water, the zero line should coincide with the level in the outer vessel. The apparatus having been shown to be perfectly sound, the flask is then gently tilted and agitated, so as to cause the gas liquor to flow slowly out of the test-tube and mix with the hypobromite solution. As the decomposition is attended with brisk effervescence, it is necessary to perform this part of the operation very carefully. When the solutions are thoroughly mixed, and the effervescence is ended, it is advisable to warm the flask by means of a flame, so as to cause complete expulsion of the gaseous nitrogen. This is attained when the solution becomes bright. The colour should also be yellow, showing that more than sufficient hypobromite solution has been used for the complete decomposition of the ammonium compounds. During the evolution of the nitrogen, it is advisable to keep slowly raising the measuring-tube so as to keep the pressure inside as near that of the atmosphere as possible. By such means leakage is guarded against. The flask is now placed in cold water and cooled down to the original temperature of the apparatus, and the increase in the volume of air originally present is read off. This, of course, is the nitrogen produced in the experiment. Its temperature is then observed, and also the height of the barometer, and from these data the observed volume is corrected.

An example will render the method more intelligible. Five cubic centimètres of gas liquor were taken and treated as described. When the apparatus had been cooled to the original temperature, which was 15° C., the volume of nitrogen (increase in the volume of air originally present in the apparatus) measured 64 cubic centimètres, and was saturated with aqueous vapour. The barometer was 29·5 inches. The 64 c.c. of nitrogen were then corrected for temperature, pressure, and aqueous vapour; in other words, it was calculated what the volume of this quantity of gas would be at 0° C. and 29·9 inches when perfectly dry.

The well-known formula—

$$(1)\qquad 64 \times \left(\frac{1}{1 + 0{\cdot}003665 \times 15}\right) \times \left(\frac{29{\cdot}5 - 0{\cdot}5}{29{\cdot}9}\right).$$

gives 58·8 c. c., the volume the nitrogen would have under the standard conditions. The number 0·5 expresses the tension of aqueous vapour at 15° C., and is found by referring to a table of the tension of aqueous vapour at different temperatures. We know that one cubic centimètre of dry nitrogen at 0° C. and 29·9 inches weighs 0·001256 gramme. Multiplying this number by 58·8, we obtain 0·0738 gramme as the weight of dry nitrogen gas from 5 c.c. of gas liquor. Hence 10 c.c. contain 0·1476, and 100 c.c. 1·476. In practice the formula giving the weight of the nitrogen obtained in the experiment is employed thus:—

$$(2) \quad 64 \times \left(\frac{1}{1 + 0{\cdot}003665 \times 15}\right) \times \left(\frac{29{\cdot}5 - 0{\cdot}5}{29{\cdot}9}\right) \times 0{\cdot}001256 = 0{\cdot}0738$$

and multiplying this number by 20, we at once obtain the percentage by weight of nitrogen in the gas liquor.

We now require to express our result in terms of ounces of strong sulphuric acid required to saturate the ammonia in each gallon of the gas liquor. One ounce of strong sulphuric acid, containing 98 p. ct. of H_2SO_4, and having the specific gravity of 1·841, is equal to 0·34 ounce by weight of ammonia gas, or 0·28 ounce weight of nitrogen. But the gallon has a volume of 160 ounces. We must therefore reduce the 0·28 of nitrogen to a percentage. As 160 : 100 : : 0·28 : x—x equals 0·175. We thus ascertain that each ounce of acid of the before-named strength required by a gallon of gas liquor corresponds to 0·175 per cent. by weight of nitrogen in such liquor. Our experiment gives 1·476 per cent. of nitrogen in the sample.

$$\text{Therefore} \quad \frac{1{\cdot}476}{0{\cdot}175} = 8{\cdot}4$$

The gas liquor by this process is thus found to have a strength of 8·4 ounces of acid to the gallon. The process then essentially consists in determining the percentage of nitrogen in the gas liquor, and dividing the number obtained by 0·175. In that way we express our result in ounces of acid per gallon, which is the method generally adopted.

The correction in this way of the observed volume of nitrogen in an experiment necessitates so much time and labour, that I feel sure the process would never be adopted in preference to other methods, whatever may be its merits, were this detailed calculation necessary each time. Fortunately we can simplify beforehand the formulæ we employ, and arrange the results in a table. Such a table has been compiled by the Gas Referees for correcting the volume of coal gas used in an experiment on the illuminating power. As is well known, the temperature and pressure of the gas are observed during the experiment, the number denoting each is then referred to in its own column of the table, and the tabular number or correcting factor is then found in the square which is common to both columns. In the present instance, we require a tabular number which shall express the corrected weight of one cubic centimètre of nitrogen at the temperature and pressure of the gas when measured. For instance, if we exclude the first factor, 64, in formula (2), and simplify the remainder—

$$\left(\frac{1}{1 + 0{\cdot}003665 \times 15}\right) \times \left(\frac{29{\cdot}5 - 0{\cdot}5}{29{\cdot}9}\right) \times 0{\cdot}001256$$

we obtain the tabular number 0·001154 for the observed temperature and pressure (15° C. and 29·5 inch). Multiplying this number by the observed volume, 64 c.c., we obtain our former number 0·073, which, when multiplied by 20, gives us the percentage of nitrogen in the sample.

Supposing the temperature of the nitrogen gas when measured to be 20° C., and at a pressure of 29·8 inches. By referring to a table of the tension of aqueous vapour we observe that it is equal to 0·68 inch. The tabular number for this temperature and pressure is expressed by the formula—

$$\left(\frac{1}{1 + 0{\cdot}003665 \times 20}\right) \times \left(\frac{29{\cdot}8 - 0{\cdot}68}{29{\cdot}9}\right) \times 0{\cdot}001256$$

We proceed in a similar way to find correcting factors for other temperatures and pressures, and arrange our results in a comprehensive table. Such a table is given at the end of this paper.

In the experiment I have cited, I have made my calculation on the assumption that all the nitrogen of the ammonium compounds is measured in the gaseous state. As the result of some scores of experiments on pure ammonium sulphate, I find that the nitrogen is under-estimated, and that when using such apparatus as I have described, in substantially the same way, there is a loss of about 4 per cent. Every 96 parts of nitrogen obtained in such experiments represent 100 parts in the sample. Making such a correction on the result we have obtained—viz., a liquor of 8·4 ounces per gallon (96 : 100 : : 8·4 : 8·75), we are enabled to say that the liquor has a strength of 8·7 ounces. A second nitrogen determination gave the same result.

The number obtained was then compared with that furnished by the mean of two very carefully conducted experiments by the distillation method. In these instances the ammonia was distilled in the presence of excess of caustic soda, and received in excess of dilute acid. The free acid was afterwards estimated by means of a standard solution of ammonia. The mean of two experiments gave a strength of 8·7 ounces to the gallon.

One determination was made by adding a known quantity of the gas liquor to excess of standard sulphuric acid, heating up to the boiling point in order to expel volatile gases (SO_2, H_2S, and CO_2), filtering off a small quantity of precipitated sulphur, and then estimating the free acid. This experiment gave a strength of 7 ounces to the gallon. It failed to determine the ammonia originally present in the liquor as sulphate.

The results obtained by the three processes on the same sample of gas liquor are—

Nitrogen Method.		Distillation.		Acid to Crude Liquor.
8·7	...	8·7	...	7·0

For the ordinary purposes of the gas manager, I am confident that the new process is sufficiently accurate to meet all his wants. The short time required for a determination is a great recommendation. An experiment with calculations can be completed in ten minutes.

TABLE *expressing the Weight of the Nitrogen in One Cubic Centimètre of Moist Nitrogen at different Temperatures and Pressures.*

In.	10° C.	11° C.	12° C.	13° C.	14° C.	15° C.	16° C.	17° C.	18° C.	19° C.	20° C.
30·5	·001221	·001216	·001210	·001205	·001199	·001194	·001188	·001182	·001177	·001171	·001166
30·4	·001217	·001212	·001206	·001201	·001195	·001190	·001184	·001178	·001173	·001167	·001162
30·3	·001213	·001208	·001202	·001197	·001191	·001186	·001180	·001174	·001169	·001163	·001158
30·2	·001209	·001204	·001198	·001193	·001187	·001182	·001176	·001170	·001165	·001159	·001154
30·1	·001205	·001200	·001194	·001189	·001183	·001178	·001172	·001166	·001161	·001155	·001150
30·0	·001201	·001196	·001190	·001185	·001179	·001174	·001168	·001162	·001157	·001151	·001146
29·9	·001197	·001192	·001186	·001181	·001175	·001170	·001164	·001158	·001153	·001147	·001142
29·8	·001193	·001188	·001182	·001177	·001171	·001166	·001160	·001155	·001150	·001144	·001138
29·7	·001189	·001184	·001178	·001173	·001167	·001162	·001156	·001151	·001146	·001140	·001135
29·6	·001185	·001180	·001174	·001169	·001163	·001158	·001153	·001148	·001143	·001137	·001131
29·5	·001181	·001176	·001170	·001165	·001159	·001154	·001149	·001144	·001139	·001133	·001127

Discussion.

Mr. F. W. HARTLEY (London) said this process at first sight looked rather complex; but, as a matter of fact, was to be admired for its simplicity. He had followed the exposition with great care, and having had some experience in processes for analyzing liquor, he might say it commanded his admiration immensely. The expedition with which the operations could be performed commended it to every practical man. As to the process of corrections and calculations, as far as he could follow them, they consisted simply of multiplications and divisions, and of a very simple nature, when assisted by tables such as could be obtained. Necessarily, in the measurement of gases, a man must be very careful indeed to take the temperature and the pressure, and if he were not so careful he was likely to fall into grave errors with a system like this; but there was no reason why he should fall into such errors. Seeing that experiments could be made so expeditiously as had been shown, this was a valuable method. Mr. Wills's system was [illegible] as that admired and used, but there were some objections to it, one being that if the heat were stopped for one moment under the flask, the whole of the liquor flew back, and destroyed the experiment. In the experiments made by Mr. Foster the results seemed almost identical with the distillation process; but Mr. Foster mentioned that the ordinary processes gave somewhat false indications, and he should be glad if a little further exposition were given about this. If cyanides or cyanates or ammonia were present, would not those things be resolved by the lime process into the useful salt, sulphate of ammonia? As far as error was concerned in the diminished quantity of nitrogen produced, it mattered little, if the error were but constant, and he apprehended that had been determined pretty accurately. If the error were constant, it ceased, in a certain sense, to be an error, because it could be easily corrected. The same thing held good with Mr. Vernon Harcourt's colour test, which also had a nearly constant error. Looking at the whole thing, he thought this method was one which every gas man who knew how to use a barometer might easily use for himself, and it appeared to him that it gave results which might fairly be depended upon. The old acid test was so uncertain in its nature, as he had shown in a little pamphlet he had published, that it gave no real indication of the strength of the ammoniacal liquor; and it was worth a gas man's while to take some trouble to determine the absolute strength, because he had to get paid for that which he supplied, whilst, on the other hand, it was desirable that the purchaser of the liquor should know what was the true strength, because he ought not to pay for more than he received.

Mr. R. O. PATERSON (Cheltenham) said he felt sure Mr. Foster would not suppose that any want of criticism of his paper was due to want of interest in it. They must all appreciate the facilities the apparatus presented, and he was quite sure they would find it answer its purpose. Mr. Foster said that presumably there was 21 per cent. of nitrates in sulphate of ammonia, but he thought that purchasers usually expected to get 24 per cent. Would that in any way influence the error he had mentioned, which he had found, so far, to be constant?

Mr. T. NEWBIGGING (Manchester) said he quite agreed with Mr. Hartley's remark, that if the small error Mr. Foster referred to was a constant error, it was not an error at all, because allowance to that extent could always be made, and he should like very much to be assured that it was really constant. He was under the impression, from the description he had listened to, that this process did not give the entire quantity of ammonia present in the ammoniacal liquor, but that it only gave the ammonia which could be detected by means of the acid. If that were so, he scarcely saw that it was a very great improvement on the acid test; but he might have misunderstood that particular point in the description of the process, because Mr. Hartley seemed to express himself strongly upon its value. He should like to know if the method of estimation explained gave the quantity of combined ammonia present, as well as that in the free state, as, if so, it was of great importance and value.

Mr. FOSTER said, in reply to Mr. Hartley's question respecting the cyanides and cyanates, that those, on being boiled with caustic alkali (soda, potash, or lime), assimilated water, and gave off ammonia, and therefore, in the determination of ammonia by means of the distillation process, where soda, potash, or lime was employed, there was obtained not only the ammonia originally present as gaseous ammonia in solution, not only the ammonia there as salts, but also the nitrogen which was present in the form of cyanides, cyanates, and the like. In each case the nitrogen came off as ammonia, and, therefore, a measure of the ammonia-producing elements by the distillation process was obtained. He believed that in working ammoniacal salts, manufacturers adopted the process of distilling with alkali (lime), so that such distillation process gave not only all the nitrogen which existed in the liquor as fixed or volatile ammonia, but also nitrogen in the condition of bodies which did not give ammonia ordinarily, in consequence of their requiring stronger agencies. Mr. Paterson had asked a question with regard to the nitrogen percentage in ammonia sulphate, but he was rather confounding nitrogen with ammonia (NH_3). There was no water of crystallization in ammonia sulphate $(NH_4)_2\,SO_4$. It was an anhydrous salt, and contained 21·21 per cent. of nitrogen, and, of course, every 14 per cent. of nitrogen meant 17 of ammonia. He was speaking of nitrogen, not of ammonia gas, and therefore if 14 gave 17, 21·2 would give something above 24. With respect to Mr. Newbigging's question, Was the error constant? That was the difficulty in the process. With this kind of apparatus he obtained result after result which gave continually 96 per cent. of the total calculated nitrogen, after making most carefully the corrections for temperature and pressure. Higher percentages might be obtained if more viscid solutions were used, but they were very objectionable. Why this slight error arose he could not at present tell, but the matter was now under investigation. Therefore the error for the purpose of the gas engineer was not sufficiently great to make the process compare at all unfavourably with those generally employed, because although the process of distillation decomposed these cyanides and cyanates, this process did not; therefore, in that respect, it was insufficient. The process gave a fairly accurate measure of the nitrogen in the liquor in the condition of ammonia and ammonium salts, whether fixed or not; it measured, in fact, the nitrogen present in what chemists called the basylous condition. Of course, in that case, they obtained fixed salts of ammonia as well as volatile. A caustic solution was used, containing not only those substances which he had described—viz., hypobromite, bromide, and water—but also free caustic soda in large excess. There was not sufficient bromine taken to neutralize or decompose the whole caustic soda. The solution was therefore strongly alkaline. On adding caustic soda to a fixed salt of ammonia, the ammonia came off at once, so that if the salt were the sulphate, this hypobromite solution, highly alkaline, decomposed such fixed salt of ammonia, and gave off gaseous ammonia, which at once underwent decomposition, as was obvious by the distinct effervescence. Therefore it would naturally give a much higher result than a liquor containing some fixed salt of ammonia, when such liquor was determined by adding the standard acid to it direct.

SALTCOATS GAS COMPANY.—At the annual meeting of this Company on the 2nd inst., a dividend on the capital stock of 10 per cent. was declared.

NORTH BRITISH ASSOCIATION OF GAS MANAGERS.

Annual Meeting in Edinburgh.

The Eighteenth Annual General Meeting of this Association was held last Thursday and Friday, in the Royal Scottish Society of Arts Hall, Edinburgh—Alexander Smith, Esq., of Aberdeen, President.

The Secretary (Mr. W. Mackenzie, of Dunfermline) read the minutes of the last annual meeting, and of the two committee meetings held since. These were unanimously approved.

New Members.

The following gentlemen were then elected members of the Association:—

ORDINARY MEMBERS.

Bremner, J.	Lima, Peru.
Duncan, A.	Falkirk.
Hall, R.	St. Andrews.
Linton, F. T.	Edinburgh and Leith Gas-Works.
M'Gillivray, H.	Pennicuik.
Rollo, W.	Kirriemuir.
Scott, A.	Falkirk.
Turnbull, J.	Lauder.

EXTRA-ORDINARY MEMBERS.

Anderson, J.	Engineer	Leven.
Thomson, J.	,,	Glasgow.

Scrutineers.

Messrs. Donaldson and Stewart were appointed Scrutineers of the balloting-papers for the election of office-bearers for the ensuing year.

The President then delivered the following

INAUGURAL ADDRESS.

Gentlemen,—Occupying as I now do for the time being the chair of this Association, allow me, in the first place, to thank you for the honour you have done me in asking me to preside over you. I feel some little diffidence in addressing you, from the fact that I stand in the presence of so many who are distinguished in the profession.

In submitting to you the usual Presidential Address, I may say that the object of our meeting here to-day is not only one of social enjoyment, but for the purpose of imparting and receiving information as to the best and most economical modes of manufacturing and distributing coal gas, in order that it may keep pace with its energetic rivals. To you, gentlemen, I look for support and assistance in order that this Eighteenth Annual Meeting of the North British Association of Gas Managers may be conducted to a successful issue.

The duty now devolving upon me yearly becomes more difficult. Most of the subjects that are of interest to us as gas managers have been ably treated by my predecessors, whose experience has eminently qualified them to thoroughly sift and lay before you all scientific principles upon which the manufacture and distribution of gas are based. And whatever improvements have taken place will be familiar to you from the pages of the Journal of Gas Lighting. I must here pause, and embrace the opportunity of referring to the loss we have sustained in the death of Mr. W. B. King, the Editor of that Journal. By this event a serious blank has been caused in the gas world. His knowledge of gas matters was of the most exhaustive character, and he was ever ready and willing to communicate to those who were in need of information. We have also sustained a loss by death of one of our extra-ordinary members, Mr. Robert Wilson, of the firm of Messrs. Hanna, Donald, and Wilson, of Paisley. He was a kind, obliging man, and, like Mr. King, was always ready to impart his knowledge and experience to those requiring it.

The *Journal of Artificial Light*, edited by Mr. J. Allan, of Edinburgh, which appeared on the 21st of September last, claims our notice. It promises to be of service to gas managers on this side of the Border, and I think it is only our duty to support the proprietors of this undertaking. Frequently hearing murmurings from many of us that we had no organ in Scotland specially devoted to our business, I would take the liberty of calling upon you to do what you can in support of this journal, by not only subscribing for it, but also by communicating to the Editor any of the more important affairs which happen in your respective localities, thus contributing to make it as interesting, attractive, and valuable as it possibly can be. I am sure I express the feelings of you all when I say that I wish it every success.

Gentlemen, this Association has proved itself to be a thoroughly successful and useful institution. One has only to look over the annual reports to see the great amount of useful information that has been laid before its members on gas engineering, manufacture, economy in consumption, utilizing to the utmost the bye-products, and other valuable inventions, thus assisting us in overcoming difficulties with which we are often brought face to face. We have only two of the gentlemen among us to-day who met 18 years ago to discuss the benefits which would flow from such meetings as these. They are Mr. Mackenzie, of Dunfermline, and Mr. Myers, of Broughty Ferry. Mr. Mackenzie has acted as Secretary and Treasurer since the formation of the Association—a post which he has filled with such great ability, and so much to the satisfaction of all. He now asks to be relieved of his duties—a request which I am sure we must grant, although reluctantly.

It certainly must be a source of congratulation to those two gentlemen to witness the Association's growing importance. Last year we had on our roll about 140 members, and to-day we have again been adding to our ranks. By the addition of every new member the Association becomes wider, and its value increases.

But, gentlemen, you are aware this is not the only large Association of the kind in Scotland; there is another, the West of Scotland Association. It has been suggested that were an amalgamation of the two to take place, a decided benefit would be the result. The West of Scotland Association has done a great deal of useful work in its time. With a view, therefore, to amalgamate with that body, our Committee have agreed to ask you to appoint a Committee of your number to meet the West of Scotland Association to confer on this desirable subject. I am convinced that if arrangements can only be successfully carried out, one powerful Scottish Association could be formed, the interest and importance of whose annual meetings would be vastly greater than that of either Association separately. Union is strength.

Seventy-seven years have now passed by since the first public illumination by means of coal gas took place. This great discovery has improved the condition and advanced the comforts of mankind. It could scarcely be expected that it could have been free from opposition. Its first foes stated that it was destructive to property, and would exercise a pernicious effect on the nervous system. They even went the length of asserting that the underground soil would become saturated with baneful chemical substances from the pipes, and that in the succeeding generation our cities would be quite uninhabitable. But in spite of these statements gas lighting has continued to grow in public favour, and has now become domesticated in every city and village of importance in the kingdom. There have been many stages of progression both with respect to apparatus and the processes of manufacture; but to enumerate these here would only be a waste of time. This, however, is quite evident, from the continued increase of production, and the greatly reduced price now charged—that gas lighting has made equal progress with the other great industries of our country, and there is no reason to doubt that it will continue to advance from year to year.

There is no very great novelty to notice in the way of improvement at this time, but I am sure there are many busy heads at work, and I have no doubt that we shall yet see our apparatus greatly simplified, and reduced in size and cost, at the same time combined with the present efficiency. Mr. Hislop's lime revivification process is being carried on successfully at the Greenock and Paisley Gas-Works. I inspected the operations, and have no doubt that economy would be effected at works where the first cost of the lime is high, and where the spent lime cannot be disposed of at a fair price.

Gas is hardly beyond the age of infancy. It will yet grow in numberless directions, and I am glad that you will have an opportunity of examining what I have referred to. Managers should recommend to their Directors or Committees to hold such exhibitions as have been held in England and elsewhere, that the public may have an opportunity of practically testing the merits of the apparatus, and seeing for themselves with what ease, cleanliness, and comfort gas can be cheaply applied for cooking and manufacture.

It has been asserted that we are on the eve of a great revolution in the mode of lighting. Much has been said and written on the subject. We have had the lime and hydro-electric lights, water and air gas, and other so-called gases, all held up before us as the light of the future; but after a little careful inspection they have all been thrown over, one after the other, and the inventors sadly exposed. I would have drawn your attention to the advisability of forming a Committee, as moved by Mr. Hislop at our last annual meeting, to investigate into reputed inventions, and to report to the Association. Agitation to the public mind would by this means be in a great measure allayed. Your Committee have again taken up the remit, and are unanimous in their decision as to its advisability; they hope, therefore, that the Association will see its way to the formation of such a Committee.

The capital invested in gas undertakings in the United Kingdom represents many millions sterling, and that so vast an amount of property should be liable to such a rapid depreciation as we have seen in connection with the electric light agitation, calls for more than a passing notice. It is to be regretted that those embarking money in undertakings of this nature do not avail themselves of opportunities of learning something of the business. Were they to do so, less heed would be paid to the sensational articles that appear both in American and in our own papers. It was those articles that caused London gas stock to suffer for a time a fall of 26 per cent.; Edinburgh, 19 per cent.; and Dublin, 33 per cent.

Electricity has been the engrossing subject of scientific development of late. It has also occupied the attention of a Select Committee of the House of Commons for nine days, inquiring into the subject, and examining witnesses of the highest scientific reputation. The Committee, in their report, say that it is not yet in a position to enter into competition with gas. Nevertheless, the Liverpool Corporation applied to Parliament, and are now empowered to light their own public buildings with electricity, and, if they carry this out, it will furnish a good deal of useful information to us. During the past year above a hundred applications for patents have been made in connection with electricity as a source of light. Many of us have witnessed practical experiments in Paris, London, and in some of our own cities, in illuminating large areas, this being the only field in which it can be used, and even in that as yet with but little success. Despite all practical tests, we still want reliable information, as to its lighting power and relative cost compared with gas. In the most favourable experiments I have yet seen, the cost is above three times that of gas. I am of opinion that it is not suited for the ordinary purposes for which artificial light is required, and where economy is regarded. I do not intend to run down the electric light, and hold up gas—the public will form their own opinion as to its merit; but certainly, as yet, there is no appearance of its taking the place of gas. Great improvements must be made in generating and distributing the current before it can commercially compete with our commodity. When its defects in connection with its becoming a generally recognized source of light have been surmounted, it will just then take its place in the field along with the other artificial light-producing agents; but the consumption of oil, candles, and gas will go on increasing yearly as long as the material to produce them can be obtained. A pure, steady, and cheap light is of the highest importance to all classes of the community. In gas we have such a light—the light of the present, and it will in all probability be the light of the future. It is continually at the disposal of the consumers, is clean, simple, and uniformly diffused. It can be easily regulated from a rushlight to 3000 candles power. This excellent result was obtained by one of Wigham's patent burners at Haisborough lighthouse.

If the streets of our cities are requiring to be more brilliantly lighted, Messrs. Sugg, Edmundson, and Bray have produced improved lanterns and burners giving a light of from 50 to 400-candle power. These burners give excellent results with gas of all qualities, and at a small cost.

It has been estimated that, in the United Kingdom, gas to the value of upwards of 2 millions sterling is annually lost in the consumption, from disregard of proper pressure, and from imperfect and unsuitable fittings and burners. Consumers in many towns can now demand a gas of a fixed quality and purity, and also a legal standard for measurement. But what of all this, when it has been clearly proved by scientific experiments that from 50 to 70 per cent. of the light that the gas is capable of affording is lost by the evil I have mentioned? How is this to be remedied? I know of no other practical remedy than by the proprietors of gas undertakings supplying architects and gas-fitters with a list of instructions and a scale of the proper sizes for internal pipes, fittings, and regulators to suit a given number of burners; and previous to the gas being turned on an inspector should be sent to see that the arrangements have been duly carried out. Further, I would have all burners proved and stamped by an appointed responsible person. The public would then have a guarantee that they were purchasing articles that would give satisfaction.

There are few manufacturing operations in which energy, order, and system are of greater importance than in the manufacture of gas, or where greater loss may occur by neglect. A fair knowledge of chemistry, machine and building construction, and drawing, are of great importance in our profession. Responsible duties being placed upon us, we should try to earn a character for ability and fairness, so that entire confidence may exist between us and all concerned.

Our business now commences. We come to share experiences with each other. The subjects to be brought before the meeting are already announced, and will be in your possession. They cannot fail to be of much interest to us, and I hope that the members will freely express their opinions on the subjects as they come before us.

On the motion of Mr. John Reid (late of the Edinburgh and Leith Gas Company), a hearty vote of thanks was accorded to the President for his able Address.

The reading of papers was then proceeded with. These, and the discussions upon them, we shall publish as soon as the Committee appointed to prepare the report of the meeting has revised them.

ELECTION OF OFFICE-BEARERS FOR 1879-80.

The Scrutineers reported that the following had been appointed officers of the Association for the ensuing year:—

President.—Mr. James Robb, Haddington.

Vice-Presidents.—Mr. James M'Gilchrist, Dumbarton; and Mr. John Reid, Leith. [It was subsequently announced that Mr. Reid, having retired from his position of Engineer to the Edinburgh and Leith Gas Company, was desirous of being excused taking an active part in the management of the Association. Mr. William Mackenzie, Dunfermline, who has been for so many years Secretary of the Association, and only retired from that position at this meeting, was then elected by acclamation in place of Mr. Reid.]

Secretary and Treasurer.—Mr. David Terrace, Arbroath.

New Members of Committee.—Mr. William Young, Clippens Shale Oil Works, by Paisley; Mr. Peter Watson, Stirling; Mr. Adam Macpherson, Kirkcaldy.

Auditor.—Mr. D. Bruce Peebles, Edinburgh.

The place of meeting next year is to be in Perth.

The meeting was in every sense of the word a marked success. The attendance of members, especially on the first day, when the greater part of the business was gone through, was large, and the discussions were well sustained throughout. Mr. Young, of Clippens, materially added to the interest of the meeting by the experiments with which he accompanied the reading of the two papers he submitted; while his remarks on several of the other papers were always listened to by the members with evident appreciation.

SOCIÉTÉ TECHNIQUE DE L'INDUSTRIE DU GAZ EN FRANCE.

[Abridged from the *Journal des Usines à Gaz.*]

As briefly recorded in the last number of the JOURNAL, the Sixth Annual Meeting of this Society was held in the Hall of the Société Industrielle du Nord, at Lille, on the 16th and 17th of June, under the presidency of M. MALLET.

The proceedings opened on the morning of the 16th with the transaction of the usual routine business, and the admission of new Ordinary Members and Associates; 29 of the former and 7 of the latter having sent in applications.

The PRESIDENT then delivered an address, in which he referred to the growth of the Society, and the work of the Committee during the past year. The experiments that had been made in electric lighting had, he said, frequently occupied their attention. They had instructed an eminent electrician to thoroughly investigate the various systems in use, and were on the point of ordering comparative experiments to be undertaken, when the several reports made to the Municipal Council of Paris by M. Cernesson and by the City Engineers, and also the work of M. Sartiaux, the Engineer-in-chief of the Northern of France Railway, were made public. Those reports having indicated the point to which the question had arrived, and given the exact cost of electric lighting, the Committee deemed it unnecessary to put the Society to considerable and useless expense. He then referred to the loss the Society had sustained by the death of several of its members, one of whom (M. Magnier) had assisted in starting the *Journal de l'Eclairage au Gaz*, and was well known not only in connection with gas literature, but as the managing director of several gas-works in France and abroad. Passing on to the financial position of the Society, he stated that an improvement had been effected over the previous year by means of additional grants from gas companies and other sources, bringing the amount thus placed to the funds up to that time to 9275 frs. (£371). While acknowledging the Society's financial progress, there was still much to be effected in the way of technical progress, and it was to be regretted that not a single paper had been sent in last year to compete for the premiums, amounting to 5200 frs., which had been offered to the members by the Committee. He urged upon the members, especially the younger ones, not to hesitate to communicate their ideas to the Committee for the general benefit of the Society. Their communications need not necessarily be learned productions; a few simple notes—divested of all elaborate formulæ and abstruse calculations—might have considerable importance, and they should bear in mind that purely practical questions played an important part in the working of a gas establishment. It was the fate of that meeting to have to turn its attention to the subject of increased illumination, either by electricity or by gas—the subject which, for more than a year, had occupied the thoughts of all those who were engaged in the gas industry, and especially of gas shareholders, whose minds had been greatly troubled by the eulogiums of the electric light that had appeared in the press. In a few months a considerable fall took place in the value of gas securities on the principal European and even the American markets, and according to the partizans of electric lighting, gas was bound in a very few years to give place to electricity, not only for the illumination of the public thoroughfares, but also for the lighting of private houses. However, since several gas companies, foremost among them being the Paris Company, which occupies the first place in the gas industry in France, had proved by their exhibitions that they were able to furnish a most resplendent light in a very simple, practical, and economical manner, opinions had greatly changed, and confidence had returned to the minds of shareholders. The President concluded by announcing that a premium of 600 frs. had been awarded to M. Monnier for his paper on "Gas Ovens," read at last year's meeting, and that the Committee proposed to set aside the sum of 5200 frs. to be distributed in premiums at the meeting in 1880.

The usual routine business of the meeting was then proceeded with, including the award of four prizes of 200 frs. each to foremen or workmen whose period of service had been longest and most satisfactory, and the sitting closed.

The following gentlemen were appointed office-bearers for the ensuing year:—M. Jordan, President; M. Ellissen, Vice-President; M. Foucart, Treasurer; and MM. Leclerc and Marché, Secretaries.

The members re-assembled in the afternoon, and again on Tuesday morning, for the purpose of reading and discussing the following papers:—

"On the Influence of the Rarefaction of Air, Barometric Pressure, and Temperature on the Illuminating Power of Gas," by M. Brémond.

"A Constant Water-Level Gas-Meter," by M. Falconnetti.

"A New English Gas Condenser and Cock with India-Rubber Closing," by M. Guitton.

"Summary of the Work on Electric Lighting written at the request of the Committee by M. Boulard," by M. Marché.

"The Recent Experiments in Lighting Public Thoroughfares," by M. Ellissen.

"On the Value of the Jablochkoff Candle in comparison with the Sugg Burner," by M. Coze.

"On the High Power Burner employed at Havre in the Comparative Trials of Gas and the Electric Light for Lighting the Port," by M. Gautier.

"On a Burner of High Power tried at Toulouse," by M. Mallet.

"Improvements in Taps with Cylindro-conic Plugs and Moveable Seats," by M. Chapa.

"A Self-registering Index for Gas and Water Meters," by M. Breittmayer.

"Purifiers in Stonework," by M. Foucart.

"Leroy's New Coke-Breaker," by M. Chevalet.

"A New Apparatus for Heating and Ventilating by Gas," by M. Roger.

"On Pressure in Gas-Mains," by M. Alavoine.

"On M. Huet's Turbine, and its Application in the Manufacture of Gas," by M. Vée.

"Relationships to be established between Gas-Works," by M. Cabassut.

"On Gas-Works Accounts," by M. Ch. Foucart.

On Monday evening the members of the Society were entertained at a banquet given by the Imperial Continental Gas Association in the Hôtel de l'Europe. The chair was occupied by M. Decroix, the Association's representative at Lille, and the Mayor and other notabilities honoured the assembly by their presence. After the banquet, the company visited the Vauban Gas-Works, which were brilliantly decorated and illuminated for the occasion. In the yard were displayed a number of gas-burners of high illuminating power, mounted upon candelabras, so as to allow of their respective merits being justly estimated. Refreshments were provided in a tent, and music lent its charms to the proceedings, which closed with a display of fireworks. The reception accorded to the Society by the Association was of the most cordial character.

On Tuesday evening a second banquet took place, by subscription, under the presidency of M. Mallet, at which the members of the Society and several guests, including M. Decroix, were present.

In the afternoon of Tuesday the members inspected the gas-works at Lille and at Tourcoing, and on the following day an excursion was made to Brussels, for the purpose of visiting the large works belonging to the Municipality. The members were met on their arrival by M. Somzée, the Engineer-in-chief, and M. Aerts, the General Manager, under whose guidance a thorough examination of the works was made, and no one could fail to admire the colossal proportions of this magnificent establishment, which does honour alike to the Engineer who designed it and to the Municipality who, to a large extent, have provided the funds for its erection and maintenance.

With this visit the business of the meeting closed, and, on separating, a hearty vote of thanks was accorded by the members to the President (M. Mallet), for the manner in which he had conducted the affairs of the Society during his term of office.

After the excursion to Brussels, several members of the Society came on to London with the object of visiting the gas-works here, and studying the manufacture of gas heating apparatus now so largely used in England. On their arrival in the Metropolis, they were met by Mr. W. H. Bennett, the Secretary of the British Association of Gas Managers, who kindly placed himself at their disposal, and with his assistance visits were paid to the principal London works, especially the Phœnix, where the members were very cordially received by Mr. Corbet Woodall, the Engineer, and a Past-President of the British Association of Gas Managers, and the Beckton works of The Gaslight and Coke Company, where Mr. G. C. Trewby, the Manager, did the honours. The following day the visitors were entertained at dinner by Mr. Woodall, who begged them to express to their colleagues the kindly feelings with which the members of the British Association regarded the Société Technique, and the pleasure they would always experience in meeting any of them in this country, as a *souvenir* of the very kind welcome accorded to those members of the Association who visited Paris on the occasion of the Society's meeting in 1878. Mr. Woodall dwelt particularly upon the mutual advantages to be derived from a frequent interchange of communications concerning the very varied processes of gas manufacture, and expressed an earnest wish that circumstances might favour another meeting of the two societies—a wish that was shared by every member of the British Association of Gas Managers. The visit was of purely an unofficial character, and the members expressed their thanks to Messrs. Woodall, Trewby, and Bennett for the cordial welcome they had received.

THE ANNUAL DINNER OF THE INSPECTORS OF THE CHARTERED GAS COMPANY.

This year the Annual Dinner of The Gaslight and Coke Company's Inspectors was held at the Crown Hotel, Broxbourne, Herts, when, on Monday, the 7th inst., about 52 of the Officers of the Company, thanks to the exertions of the Dinner Committee, most thoroughly enjoyed themselves, the various sports and pastimes being well patronized, and a really superior dinner being provided, full justice to which was done. The chair was occupied by Mr. T. Fenn, and the vice-chairs by Messrs. G. Church and T. J. Bird, District Chief Inspectors.

The cloth being cleared, the Chairman proposed the usual loyal toasts, Mr. W. Wright, who ably presided at the piano, playing the National Anthem and "God Bless the Prince of Wales." Then followed the toast of "Success to The Gaslight and Coke Company," coupled with the name of J. O. Phillips, Esq., the Secretary, to which Mr. Bird responded. Mr. Church then gave the health of T. C. Hersey, Esq., the Chief Inspector, and Mr. Dillon responded in the much-regretted absence of the former gentleman. Mr. Bird, in a very feeling and pathetic speech, gave "To the Memory of our Late Lamented, Esteemed, and Respected Chief, J. Johnson, Esq., Deceased," whose loss all present seemed to feel deeply. In connection with the death of Mr. Johnson, Mr. Bird mentioned that since the meeting of the previous year three deaths had taken place from among the number who were then present. The toast was drunk in silence. "The Rental Department" was the next toast, and in the absence of Mr. Vaughan, the chief of that department (who sent a telegram apologizing for his inability to be present), Mr. W. H. Friend responded. "The Stores Department" followed, and was ably responded to by Mr. Pearson, the Chief Storekeeper, who, in a few well-chosen words, remarked that it gave him very great pleasure to be present; Mr. M'Minn, sen., following him, and endorsing all he had said. Mr. Osborne next proposed the "District Chiefs," to which Messrs. Young and Dillon responded. The Chairman then gave "Prosperity to the Widows Fund," coupled with the name of Mr. S. J. Ball, who briefly responded. "The Ladies" were not forgotten, their health being proposed, and afterwards responded to by Mr. Parry, jun., who proved a very able champion for the fair sex. The Chairman's health was next given, and responded to by Mr. Fenn, who stated that it gave him great pleasure to preside over such a happy and festive meeting. He followed by proposing the health of the Vice-Chairmen, to which Messrs. Church and Bird responded, the latter giving, as the final toast, "The Dinner Committee, or Stewards," who were Messrs. Browning, Ditchman, Poulton, Wigley, Osborne (President), Roberts (Hon. Treasurer), and Ball (Hon. Secretary), to which Mr. Osborne responded, after which a photographic picture was taken of the whole of the party. Altogether, a most pleasant and thoroughly enjoyable day was spent. We must not forget to mention that the proceedings were enlivened by some most excellent songs and recitations by Messrs. Ferrars, Browning, jun., Stephenson, Dillon, Wigley, Downs, Parry, jun., Peck, Coppeck, and others.

THE PROPOSED SUBSTITUTE FOR CANDLES IN TESTINGS FOR ILLUMINATING POWER.

The following is the letter referred to in the "Circular to Gas Companies" of the 1st inst. as having been recently addressed by Mr. A. G. Vernon Harcourt, one of the Metropolitan Gas Referees, to the Assistant Secretary of the Board of Trade:—

Sir,—I desire to call the attention of the Board of Trade to the untrustworthiness of the standard which is at present in use for estimating the illuminating power of coal gas.

I desire also to obtain the sanction of the Board of Trade to the introduction at the testing-places established for testing gas supplied by The Gaslight and Coke Company, the South Metropolitan Gas Company, and the Commercial Gas Company, of a more trustworthy standard.

Under the Acts of the above-named Companies, the Gas Referees are charged with the duty of prescribing the materials and apparatus to be used within the testing-places for testing the illuminating power of gas. Soon after my appointment, in 1872, as one of the Gas Referees, in the course of experiments upon the effect of heating gas with a view to its purification from sulphur, the inaccuracy of the usual photometric process was brought under my notice. In 1874 I began a series of experiments, with the aim of devising a more trustworthy process, which have continued with occasional intermission till the present time.

In the course of my experiments I have had occasion to make a large number of testings with candles of the kind ordinarily employed, and also with candles differing in diameter and in the structure or preparation of their wick, but coming within the definition of "sperm candles of six to the pound, consuming 120 grains of sperm per hour."

For some account of the results of these experiments, I may be permitted to refer to a paper "On a New Unit of Light," read before the Physical and Chemical Sections of the British Association, at its meeting in Plymouth, in August, 1877, a copy of which accompanies this letter.*

The existing system of photometry attempts to neutralize the variations in the amount of light emitted by standard candles by using two candles simultaneously, and by extending each testing over a period of ten minutes. The further provision that three testings shall be made daily, and that the mean result of the three shall be taken to represent the illuminating power for the day, though intended to provide for fluctuations in the quality of the gas supplied at different hours, really serves also to neutralize the variations of the standard candles.

This method of obtaining a fairly accurate result by taking the mean of a number of experimental results varying considerably one from another, is rightly used, and leads to correct conclusions, when the experimental errors are likely to be evenly distributed, and when the whole series of observations is not liable to be affected by a common cause.

Thus, if a single candle were employed to yield a standard light, and if the correspondence between its light and that of a gas-flame were observed during one or two minutes, the variations in the results obtained by the same operator using the same candle in the same photometer would be very great. In the actual mode of working, the variations are not very great. According to my experience, it does not often happen that any one of a set of three testings varies by more than half a candle from the mean of the three. This is the case even if a different pair of candles is used for each testing, when the candles are from the same packet, and the mode of operating is kept rigorously uniform.

In Appendix I., I have put together the results of a large number of candle-testings made in my laboratory with the view of obtaining a receipt for preparing a gas from hydrogen and pentane, which should have, when consumed by a standard burner, exactly the illuminating power of 16 candles.† Such a gas might be used as a photometric standard in the manner which I described and showed in a lecture before the Society of Arts on the 31st March, 1876.‡

Three testings were made of each sample of gas, stored in a small gasholder, in quick succession one after the other, so that the light given by the gas did not vary, and the variation between the three results is due solely to errors of observation, which are inconsiderable, and to differences in the illuminating power of three different pairs of candles treated similarly in every respect. The numbers have been corrected, as usual, on the assumption that the light given by similar sperm candles varies directly with the weight of spermaceti consumed; and where the consumption of gas was in any degree greater or less than 5 cubic feet an hour a proportional correction has been introduced.

The conclusion which may be drawn from this large number of observations is, I think, that when candle testings are made with great uniformity, fairly concordant results may be obtained. It is, no doubt, owing to the fact that concordance is attainable under these conditions, that an amount of confidence is bestowed upon candle testings to which they are not really entitled. In fact, the greater pains an operator takes to obtain concordant results by working in a perfectly systematic and uniform manner, the less significant and trustworthy does his mean result become.

The result of the testing by candles of any sample of gas depends upon many conditions beyond those named in the Companies Acts of Parliament and in the notification of the Gas Referees, and is affected by causes the influence of which the actual application of the method of averages does not tend to eliminate.

I will here point out a few of these, in addition to those mentioned in the accompanying paper.

1. Since the prescription by the Gas Referees of the apparatus to be used in the Metropolitan testing-places, which included a balance external to the photometer for weighing the candles used in testing, a new form of balance has been substituted by Mr. Keates, Chemist to the Metropolitan Board of Works, by which the candles are weighed *in situ* within the photometer. The plan of weighing the candles *in situ*, or of observing, without moving or extinguishing the candles, the time required for the consumption of 40 grains of spermaceti, is both less troublesome and more accurate. Its introduction is therefore a boon to the Gas Examiners; but I believe that it is also a boon to the Gas Companies, since it is practically impossible to transfer a pair of lighted candles from a balance to the photometer without filling the cups of the candles with melted grease, and thus increasing the light of the candles, probably by diminishing temporarily the length of wick within the flame.

2. Some operators make a point of trimming the wicks of their candles; others of leaving them alone. I have known a difference of 2 candles to be made in the illuminating power attributed to a sample of gas, by simply bending down slightly the wicks of the candles between a first and second testing. A similar difference may be produced by cutting off the tip of the wick.

3. The greater or less movement of the air round the candles in an open photometer, and the greater or less movement of the candles to and fro in a box photometer, according to the habits of the operator, affect considerably the result of a testing, or set of testings. Perfect stillness is unfavourable to the development of the light of a candle; and this, I believe, is one reason why open photometers sometimes give results less favourable to the gas than box photometers.

4. The mode in which a candle has been extinguished, and the time during which it is allowed to burn before a testing is made, are also points of some importance, as to which the practice of different operators is different.

5. The age of the candles is said to make a difference in their burning. Mr. Heisch, who has had much experience in photometry, has told me that he finds it best to buy candles and keep them for some time before using them.

6. Candles with 18 threads in each strand of the wick generally burn less than 120 grains of spermaceti an hour, and candles with 21 threads generally burn more. After correcting for the excess or defect of consumption, the results obtained with the former candles are about half a candle less favourable to the gas than those obtained with the latter.

7. The candles which I have been accustomed to use, and I believe also those sent by Mr. Keates to the testing-places, are made by Mr. Miller, of Dorset Wharf, Westminster. According to some recent experiments, a summary of which is given in Appendix IV., in which the same sample of gas has been tested both by Miller's candles and by those of another maker named Brecknell, the candles of the former maker give for the same consumption of spermaceti 6 or 7 per cent. more light than those of the latter.

The above list might be extended by the enumeration of other details in which the practice of one Gas Examiner may differ from that of another, with the result of producing a material difference in the illuminating power attributed to two precisely similar samples of gas.

I submit, therefore, that the standard now in use is not sufficiently definite and uniform to be maintained as a standard; and that it is desirable, if possible, to substitute for it a standard more definable in its nature, and less liable to be affected by the manner in which it is used.

In the paper "On a New Unit of Light," to which I have referred, a description is given of the standard which I propose as a substitute for the sperm candle. A more extended comparison of the illuminating power of this standard flame with that of various sperm candles has led me to make a slight alteration in the height of the flame, and in the proportion of pentane used in preparing the standard gas. The height of the flame burning from a $\frac{1}{2}$-inch aperture, which is most nearly equal to an average sperm candle flame, is $2\frac{1}{2}$ inches. The volume of liquid pentane which is to be poured into 3 cubic feet of normal air is 9 cubic inches, measured at 60° Fahr.

The photometric comparison of the sample of gas to be tested with this standard flame may be made as when candles are used. But I find it more convenient, and equally exact, to keep the disc at rest in the position corresponding to the normal illuminating power of the gas (*e.g.*, for 16-candle gas, four times as far from the gas as from the standard), and the standard flame also at rest. The observation is made by regulating the consumption of gas till the disc is equally illuminated on both sides, and then ascertaining by reading the meter once or twice, at intervals of one or two minutes, what the rate of consumption is.

In the system of gas-testing used in Paris, the return made is not of the illuminating power of the gas when burning at a particular rate, but of the volume of gas required to maintain a certain amount of light for a certain time.

I venture to think that this system is more exact and more reasonable than the system in use in this country.

It is more exact because the same burner may be used with equal advantage to produce the light of (*e.g.*) 16 candles from different samples of gas burning at very different rates; but the same burner cannot be used with equal advantage to consume at a fixed rate of (*e.g.*) 5 cubic feet per hour samples of gas varying to anything like the same extent in their illuminating power.

It is also, I venture to think, more reasonable because the difference to the consumer of being supplied with a richer or poorer gas is measured, not by the illuminating power of the gas, but by the volume of gas which he requires to burn in order to obtain a fixed amount of light. For example, if on any evening the consumers in a London district were supplied with 14-candle gas instead of 16-candle gas, their houses would not be less well lighted than at other times, but they would use and would have to pay for about 10 per cent. more gas.

Considering, however, the difficulty of changing a custom and nomenclature established in popular usage and in Acts of Parliament, probably the change of system could only be effected indirectly; and the alteration I have suggested in the photometric process would indirectly effect this change, if in the calculation of the result it is assumed that the illuminating power of the gas burnt so as to yield a fixed amount of light varies inversely with the rate of consumption.

It is the case that this inverse relation exists with the standard burner for samples of gas varying from rather below 16 candles up to 17 candles illuminating power; and nearly all the gas tested at the Metropolitan testing-places falls within these limits. Thus, for the ordinary range of the testings of illuminating power made upon the gas supplied to the Metropolis it is immaterial which system is employed. If the gas supplied falls considerably below the standard quality, the deficiency appears to be greater when the gas is consumed at a fixed rate and the light which it yields is determined, than when the observation is of the rate of consumption requisite to yield a fixed amount of light. The cause of this is partly general, that comparing larger gas-flames with smaller the gain in illuminating power with the larger flame is more than in proportion to the increased consumption; in part it depends upon the particular burner employed, which is constructed for producing a flame giving a light of from 16 to 17 candles.

How rapidly with this burner the yield of light diminishes when the consumption is reduced, may be shown by making a great reduction, such as from 5 cubic feet per hour to 4 cubic feet. In this case the light is reduced from that of 16 to that of little more than 8 candles.

The numbers representing the illuminating power of gas estimated in the manner here proposed would truly represent the advantage to the consumer of the sample of gas supplied to him, as far, at least, as it is possible to infer, from any testing with one burner chosen as a standard, what the effect of a change in the quality of gas is with other burners. A fall in the quality of the gas from 16-candle to 15-candle would represent an increase in the charge made to the consumer of 1-15th, or $6\frac{2}{3}$ per cent. For the quality of the gas thus estimated, "illuminative value" is a better term than "illuminating power."

Before a change could be made in regard to the existing standard of photometry, it is necessary not only that a more trustworthy standard should have been devised, but also that the relation between the old and the new standard should have been ascertained as definitely as possible.

The more fluctuating and uncertain the existing standard is, the greater is the difficulty of ascertaining exactly this relation.

In Appendix II., I give a summary of experiments made in Oxford with the view of fixing the exact composition of the mixture of pentane and air, and the exact height of the flame produced by the burning of the mixture, which should be the representative of a standard candle flame,

* See JOURNAL, Vol. XXX., p. 337.

† Important as are the appendices which accompany this letter, space will not admit of their being given in the JOURNAL; they occupy 19 pages of printed foolscap, and consist largely of tabular matter.

‡ See JOURNAL, Vol. XXVII., p. 620.

and also should furnish a convenient rate of consumption, such as half a cubic foot per hour.

In Appendix III., I give a summary of a small number of similar experiments made with a different form of photometer.

Appendix IV. contains the results of a series of experiments, still in progress, made with a third photometer by Mr. Frank Livesey, at the works of the South Metropolitan Gas Company.

As I cannot expect, and do not wish that the Board of Trade should sanction so considerable an innovation as the substitution of a new for an existing standard on the evidence supplied by one person, I venture to ask that an independent inquiry into the relative merits of the existing standard and of that which I have proposed may be instituted.

If the Board of Trade should be willing to appoint two or three scientific men to inquire and report to them on this subject, I will gladly assist the inquiry in any way that is open to me.

(Signed) A. Vernon Harcourt.

THE WATER SUPPLY OF HALIFAX.

At the Meeting of the Halifax Town Council on Wednesday, the 2nd inst.—the Mayor (Alderman Midgley) in the chair—a minute of the Water-Works Committee was brought up, to the effect that they had resolved that notices to treat, under the powers of the Halifax Water and Gas Extension Act, 1876, should be given to the various owners and occupiers of lands required for the construction of the reservoirs and other works connected with the water supply of the borough at Walshaw Dean.

The confirmation of the minutes having been moved,

Mr. Booth proposed an amendment excepting the foregoing minute. He thought the present supply of water was such that, for the next 50 years, at any rate, there was no probability whatever of a further supply being required for Halifax. There might be reasons for additional outlay, but at present he had no information which would lead him to support a resolution of that kind, which would entail an expenditure that would probably raise the rates by something like 10d. in the pound. As he understood, if this land were purchased, they would be compelled to construct the reservoir before the year 1886. The cost of the reservoir and the land would be close upon £200,000, which would entail an expenditure of fully £10,000 a year. The Corporation were already raising by rates £10,000 a year to cover the loss sustained by the enormous supply of water running to waste, and he could not understand why the Water-Works Committee should recommend the Council to approve of an act that would entail a further burden upon the ratepayers. It might be urged that as the time prescribed under the Act to purchase the land expired this year, it was a necessity that the matter should be looked into; but he could not see why the land should be bought at present. Supposing their powers expired this year, there was no fear but that at some future time, if they wanted a further extension of the water-works, this land would still be as available for them. If they laid out something like £200,000 within the next half-dozen years, in 50 years (and it would be far more than 50 years before the scheme was wanted) they would have more than trebled the cost, which, instead of being £200,000, would be something like £600,000. Therefore, he thought the Council ought to hesitate before passing a resolution of that kind.

Mr. M'Knight seconded the amendment.

Alderman Longbottom said the steps taken by the Water-Works Committee were a matter of course. The powers for acquiring these lands at Walshaw would expire in September next, and it was deemed necessary by the Committee to take some action with a view not to allow these powers to lapse. But it was not the intention of the Water-Works Committee, if they could avoid it, to go to the immediate purchase of the land or the construction of the reservoirs.

Mr. Pearson mentioned that Mr. M'Knight had had an interview with the Town Clerk of Wakefield, who assured him that Wakefield was not at all likely to be a customer for the Halifax water, having had a liberal offer from Huddersfield at 4d. per 1000 gallons. It seemed inopportune and unnecessary to purchase so largely as was now spoken of, and to construct in a short period expensive works. Surely they had quite enough to do to meet the present demands on the Corporation. Suppose the powers should lapse, he thought it quite likely that the land would be at liberty in 10, 20, or 30 years, if the Corporation required it.

The Mayor said members of the Council should be very careful about giving opinions or making statements, unless they had information on the subject. He assured them the Water-Works Committee had been anxious for years upon this very point. The amount the Council had to make good upon water account out of rates last year was £9000 or £10,000. The question was how best to get out of the difficulty, and he believed the Council would have been unanimous if they had had the same information before them as the Committee. Mr. Booth said that the supply from the present reservoirs would be sufficient for 50 years. That was a statement easily made, and he did not know how he had arrived at that period, but he thought it a very easy matter to show him that, under ordinary circumstances, a very much shorter period would elapse before they should be compelled to make the other reservoir. They had now reservoir room for 6¼ million gallons daily. There never had been a period since they began supplying local boards when they had been able to dispose of more than two-thirds of their water—indeed, they had very rarely approached that quantity. Instead of having 6¼ millions, therefore, they could not sell more than 4 million gallons a day with all their vast resources. At the present moment they were selling about 2½ million gallons. They were consuming through meters three-quarters of a million; selling to local boards about three-quarters of a million; and they calculated that the domestic supply was just about one million. It would be a very weak thing on the part of the Corporation to sacrifice the best gathering-ground they had possession of, giving the owners the opportunity of making contracts with other people if they so wished. If the Corporation were to sell every gallon of water they could (because they must always allow one-third for leakage), it would cost them over 6d. per 1000 gallons, and to talk about selling water at that price and making profit out of it was a delusion. He believed the day had gone by when the Halifax Corporation would make any further bargains for supplying local boards at 6d. per 1000 gallons. What they had to do now was to be as careful as they possibly could to take advantage of the best bargains they had made, and to retain to themselves the gathering-grounds they had possession of. He was quite satisfied it would be the essence of weakness to give up possession of this land; they ought to be so situated as to make the best bargain with the owners in order to secure it at the most convenient period for themselves, and then to make the reservoirs when the water would be required. By looking carefully after the leakage, it was possible the Committee might be able to supply water at a future time at less than they were doing now, and perhaps at as little as to local boards, but nothing but the greatest prudence would bring that about.

Mr. Shaw had great pleasure in supporting the resolution. He thought it would be the greatest mistake the Corporation had ever made if they allowed the ground to pass out of their hands.

Mr. Worsick asked the acreage and probable cost of the land.

The Mayor said there were about 180 acres, and it was nearly all moorland.

The Town Clerk said the parliamentary estimate was £10,000 for the land.

After some further conversation, Mr. Booth said if he could have had an assurance that the reservoirs would not be made within the time prescribed, he would not object to spending £10,000 on the land. What he did object to was committing the Council to laying out £200,000.

The Mayor: There is not the slightest danger, because the Water-Works Committee cannot do anything without the consent of the Council.

The amendment was then withdrawn, and the minutes were passed.

THE WATER SUPPLY OF WAKEFIELD.

A Special Meeting of the Wakefield Town Council was held in the Town Hall on Tuesday, the 8th inst.—the Mayor (Mr. T. Taylor) in the chair. The principal business was "to consider and determine as to the desirability of promoting a Bill in the next session of Parliament for empowering the Council to obtain a supply of water for the borough and neighbourhood from the Rishworth Moors, near Ripponden, in the West Riding of the county of York, and to construct the necessary conduits, reservoirs, and other works in connection therewith, and to raise moneys for the said purposes; and, if it should be thought advisable to promote a Bill for securing the said objects, to pass all such resolutions and direct all such proceedings to be taken relative thereto as the Council may think fit."

Mr. H. Lee, Chairman of the Water-Works Committee, in introducing a motion in favour of promoting a Bill with the above object, said that this was a matter of so much gravity that the effect of whatever the Council decided at that meeting would be felt almost a century afterwards. If they adopted the course which was now proposed, they would incur responsibilities which would extend over 100 years; but, on the other hand, if they rejected it, they lost the last opportunity which Wakefield had of obtaining a gravitation scheme of water supply. If they could feel certain of having a continuous supply of such water as they had at persent, he would have hesitated before taking a step such as this. But they could not feel certain that either in quantity or quality they would continue to have their present supply. During the past two years there had been an unprecedentedly heavy rainfall; but in 1873 and in 1874, when the average rainfall was about 17 inches, the water which came down the river was repulsive to the smell, to say nothing of having to drink it. In the years 1877 and 1878, however, the average rainfall was 34 inches per annum, or about double what it was four years before. But Nature, like History, repeated itself, and as surely as there was an excessive rainfall now, so surely would dry seasons succeed, and when that happened he almost trembled to think what would be the position of the town in regard to its water supply. It would become absolutely necessary to have a new supply from some source—either a supply beyond the present one, or they must expend more money in sinking wells or constructing additional filtering-beds in connection with the present works. He did not think that any thoughtful member of the Council or inhabitant of the town would take the responsibility of going to the River Calder for an increased supply of water. In 1873 the annual consumption of water in the town was 406 million gallons, and in 1878 the consumption had increased to 536 million gallons. If the same rate of increase continued, therefore, during the next seven years—and there was no reason to doubt that it would—it would be absolutely impossible that they could supply either the quantity or the quality of water they were supplying now. The Water-Works Committee, therefore, having given those circumstances their careful consideration, thought that it was desirable to make an attempt to find a new source of supply. They had consulted their Engineer, Mr. Filliter, and instructed him to make a survey of the district. He accordingly made a survey, and submitted what had since become known as the Rishworth Moor scheme. The present consumption of water was about 1½ million gallons a day. Mr. Filliter had drawn up two schemes—one for supplying 2 million gallons, and the other 3 million gallons of water per day. And the Rishworth Moor scheme would supply the latter amount when it was required. The Darfield scheme, costing £98,000, borrowing the money at 4 per cent., to be repaid in seventy years, would require an annual income of £4960; working expenses, £3040; expenses of the offices, £750; making a total of £8750. Then they must add to this the interest on their present undertaking, £210,000, which required an income of £8977 10s., making the net revenue which they would have had to raise £16,957 10s. Mr. Filliter estimated that the Rishworth Moor scheme would cost £160,000. To pay that off in the same term at the same amount of interest would require an annual income of £6840, the working expenses were estimated at £500, and the office expenses at £750, making the total income required for the new works £8090. They must add to this the interest on their present undertaking, £8977 10s., which would make the total revenue necessary £17,067, so that the Rishworth scheme for the same quantity of water would only cost about £100 per annum more than the Darfield scheme. The great difference was that in the Darfield scheme there must always be an expenditure of £3000 a year for the cost of pumping, whilst in the other scheme that sum would go towards the repayment of the principal and interest. In a report on the Rishworth Moor scheme, Mr. Filliter stated that "the Rishworth Moors are a wide tract of uncultivated land, situate at a height of between 1000 and 1500 feet above the sea, and about six miles south-west of Sowerby Bridge. They form the gathering-ground of the Booth Dean Clough, a stream which falls into the River Ryburn at Slithero, about a mile above Ripponden. The annual rainfall on this lofty ground is somewhat heavy, being from 45 to 50 inches in depth, and, after making the usual deduction for evaporation and for compensation to mills, will, in dry seasons, enable a supply of 1 million gallons per day per 1000 acres to be stored and sent forward for the use of Wakefield. About 2000 acres can be dealt with at once, and another 1000 acres can also be dealt with when wanted. This will give two million gallons per day for the present, and an additional million gallons per day when the demand arises. The cost of the works for the first part of the scheme is estimated at about £160,000, and for the additional million gallons per day about £60,000." There was no doubt that in a scheme of this magnitude there must always be considerable uncertainty as to cost. But in order to obtain an approximate notion of what their responsibilities might be, they might suppose that the total cost would reach £210,000, which would bring the total amount they would have to raise, when the new works were in operation, up to £19,205. The present income from the water supply was £13,968, but if the demand increased during the next five years as during the past five, by the time the new supply was ready the town would require the whole of the 2 million gallons of water per day, which would bring up the income to £18,133, leaving a deficiency of about £1000 to be provided out of the rates. A penny in the pound on the present rateable value realized about £500 per annum, and there was at present a rate of 2d. in the pound which expired in two years, so that their position would not be so serious as many of the ratepayers seemed to imagine. The matter was one demanding serious consideration apart from all party or personal motives. He concluded by moving the adoption of the motion.

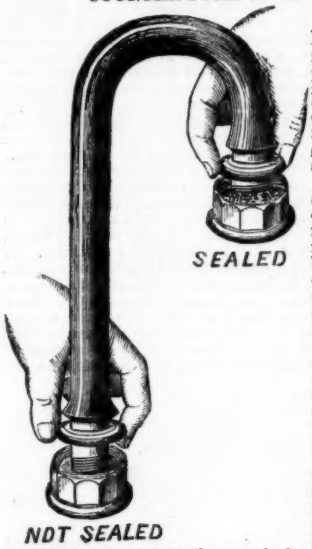
Alderman GILL, in seconding the motion, said that he had no misgivings about this being the right course to take. The experience of the past left the Water-Works Committee no other course than to look for a new source of water supply. He defended the past action of the Council in regard to the water-works and the water supply, and maintained that this was one of the most important measures for the welfare of the town which had been brought forward for a long time. If the town was to prosper as a manufacturing centre, an adequate supply of good water was an absolute necessity.

Mr. CUTHBERT said that this proposal involved a responsibility so serious that he was not prepared to accept it. He admitted that the water at present supplied was not all they could wish; but the scheme which the Committee proposed would meet with the strongest opposition from Sowerby Bridge, from Halifax, and especially from the Aire and Calder Navigation Company.

Alderman STEWART said that when the inevitable came, the wisest and most economical course was to accept it. They were told by the Rivers Pollution Commissioners that it was an utterly monstrous thing that a civilized community should be found, by an expensive chemical process, purifying for its own consumption, its own sewage, and the sewage of a population of half a million people. The only justification for it could be that there were no other means of supplying the town with water. But if there were other means of supply, it was monstrous that a body of men calling themselves a Local Board of Health should deliberately give to the people of Wakefield what was nothing less than purified sewage. He maintained that the reason why they had purchased the water-works was that they might improve the water supply. It was impossible to increase the supply from the Calder.

The motion was then put, and carried, and the Council adjourned.

COUNTER-SUNK SEAL GAS-METER UNIONS.



On the 14th of May last a patent was applied for by Mr. G. F. L. Foulger, of Bow, for "Improved Means in connection with Gas-meters for preventing the Fraudulent or Unregistered Consumption of Gas," the apparatus, which the inventor calls a counter-sunk seal gas-meter union, being shown in the accompanying illustration.

By the use of unions such as this, a gas company's property is practically placed under lock and key, by rendering it impossible to disconnect at any joint at which gas could be obtained unregistered, without destroying the company's seal or signature, whilst a small cover absolutely protects the impression from accidental injury.

A meter having been fixed with one of these unions on the main-cock, and another on the inlet, a few pinches of specially prepared crushed sealing-wax is placed in the cup, and being melted with a blow-pipe, the wax runs between the reversed threads. A circular tong-shaped die is then used to give a sharp impression of the gas company's title, an operation requiring about two minutes in all to perform. If heat is applied for the purpose of unsoldering the joints, the wax is instantly fused, and the impression, of course, lost.

We may mention that the Chartered Gas Company have just given an order for a number of these unions for trial in their district.

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

The coal trade of this district is in an extremely depressed condition. During the last two or three weeks there has been an almost complete cessation of the demand for the better classes of round coal for house-fire purposes, in addition to which a considerable falling off in the requirements of iron and other works for the lower classes of round coal is also reported in many quarters. Although nominally list rates are without material alteration, prices generally are easier, and there is a good deal of pushing for orders at very low figures. Good Wigan Arley for house-fire purposes could be readily bought at from 8s. to 8s. 6d. per ton at the pit, and common sorts at from 6s. to 7s. per ton, with Pemberton four-feet ranging from 6s. to 6s. 6d., and common round coal from 4s. 6d. to 5s. 3d. per ton. In the gas coal trade extremely low prices continue to rule, and for good screened gas Arley at the pit mouth not more than from 6s. to 6s. 6d. per ton is being obtained, whilst the common classes of gas coal are almost unsaleable in the face of the low prices at which the better qualities can now be obtained. For cannel, very low figures are also being taken, but these vary considerably according to quality. The Manchester Corporation, I understand, have secured gas coal contracts to cover their requirements for the next two years, at prices ranging from 7s. to 8s. per ton for good qualities delivered at the works, some of which, I believe, is even being sent out of Yorkshire, and they are now asking for tenders for deliveries to commence three years hence. Burgy still meets with but a very moderate demand, and slack continues very low in price, especially in the neighbourhood of Manchester, where heavy stocks are held, and it is only in a few districts where colliery proprietors are favourably situated for getting rid of this description of fuel that prices show any signs of firmness. For good burgy the quotations at the pit mouth are about 4s. to 4s. 3d. per ton, and slack can be got at from 2s. to 3s. 3d. per ton, according to quality.

There is extremely little doing in the shipping trade, and very low prices are ruling in the market.

In the iron trade there has been but a very limited amount of business doing during the past week, with a downward tendency in prices. Very little Lancashire pig iron is at present being sold, and foundry qualities delivered equal to Manchester could be bought at about 44s. per ton, less 2½ per cent. Finished iron is also very low in price, and for anything like a good specification common bars delivered into the Manchester district could be bought at from £5 2s. 6d. to £5 5s. per ton.

THE COAL AND GENERAL TRADES OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

July is usually the dullest month in the year for the gas coal trade. But for the contracts, which involve a pretty uniform shipment of coals all the year round, the best gas collieries would be short of work, as there have been few orders in the open market lately. The only business of importance transacted during last week was a small contract which was made to supply the gas-works at Christiania with coals at a rate slightly over 6s. a ton—hardly 6s. 3d. The second-class gas pits are absolutely without business—they are working short time, more or less. Prices are low, and the outlook for the autumn does not seem to be remarkably hopeful for them, as most of the gas companies prefer the better qualities of coals at the present prices. Several more cargoes of gas coals were shipped for Ireland last week. The smaller gas companies are evidently taking advantage of the somewhat depressed state of the market, and the low rate of freights current, to make up their stocks for the autumn.

A little difficulty is experienced in the northern coal ports at present in securing a handy class of sailing tonnage, say of from 10 to 15 keels each, for coasting purposes. There has been a rise equal to 3d. per ton in freights of this description all round. This slight firmness is likely to be upheld, as the requisite number of vessels are not reaching the coal ports. Small foreign ships are scarce this year. In consequence of this, merchants are taking up little handy sailing ships to load coals for the nearer ports of the Baltic when they have the opportunity, and as business here is bad, they have to pay more money to the shipowners on the outward passage. This, of course, reacts upon the coasting trade. But the change is not, nor is it likely to be, very material, as may be judged by the fact that 4s. 10½d. per ton was paid to sailing vessels last week to carry gas coals to London to be discharged at the wharf, and that as low as 3s. 10½d. was a rate paid to a steamer to take a cargo of coals to London.

A number of small ships have been taken up for loading gas coals for Ireland. The rates offered at Newcastle on Saturday to small ships to load gas coals were as follows:—Penzance, 6s.; Plymouth, 5s. 10d.; West Port and Galway, 7s. 6d.; Dublin, 6s. 6d.; Dover, 4s. 9d.; Whitstable, 5s.; Torquay, 6s.; Brixham, 6s.

The foundries are getting slack. At the same time a pretty considerable number of gas, water, and sanitary pipes are being manufactured in the county of Durham. The iron trade of the Cleveland district continues in a most unsatisfactory condition. Business is decidedly worse there. The chemical market here is quiet. The demand for the better qualities of fire-clay goods is pretty well sustained. So also is the demand for cement. Ordinary Spanish lead is selling at £13 10s. per ton. Red lead is likewise cheap.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

In opening my budget of "Notes" this week, I would just take the merest passing notice of the Eighteenth Annual Meeting of the North British Association of Gas Managers, which was held in Edinburgh last Thursday and Friday. It was certainly the most successful meeting of that body which has yet been held. The opening Address by the President, Mr. Alexander Smith, of the Corporation Gas-Works, Aberdeen, was characterized by a degree of brevity which is not common in presidential addresses; but it was pointed, interesting, and instructive, and well suited to the occasion. The subsequent proceedings had far more than the ordinary amount of interest attaching to them, and in some respects they were of such a character that their fruits may only be expected in the future, when the facts brought out come to be known, studied, and applied in practice. These remarks are especially true of the two papers by Mr. Young, of Clippens Oil-Works, and the experimental demonstration by Mr. D. Bruce Peebles, of the close relationship between the pressure at which gas is burned and the illuminating power developed during its consumption. An interesting and lively discussion was excited by a paper read by Mr. James M'Gilchrist, of Dumbarton, on "The Circumstances Affecting the Price of Gas;" and it is not unlikely that the discussion upon it will be resumed when the paper is itself printed *in extenso*. Mr. M'Gilchrist is a gentleman who does not hesitate to hit hard, or to call a spade a spade; but he never hits below the belt, and his efforts to maintain the interest of the discussions in which he takes part are usually attended with success. There was a very large attendance of members, some of whom came from "across the border" and from Ireland. Mr. Robb, of Haddington, was elected as the new President. Mr. Mackenzie, on his resignation of the secretaryship, which he had held from the birth of the Association, was elected as one of the Vice-Presidents; indeed, but for his most retiring disposition, he would have been unanimously elected to the post of President. He is succeeded in the secretaryship by Mr. Terrace, of Arbroath. The next meeting of the Association is fixed to take place at Perth.

The Directors of the Nairn Gaslight Company have recommended to the annual meeting of Shareholders to declare a dividend of 5½ per cent., and to reduce the price of gas from 8s. 9d. to 8s. 4d. per 1000 cubic feet.

The annual general meeting of the Laurencekirk Gas Company was held on Wednesday, in the Town Hall—Mr. D. A. Pearson in the chair. The usual dividend of 7½ per cent. was agreed to, and the Directors (with one exception), Auditors, and Officials were all re-appointed.

At the annual meeting of the Kirriemuir Gas Company, which was held last Thursday, a dividend and bonus were declared at the same rate as formerly—namely, 6 per cent. and 2 per cent.; and the price of gas was continued at 6s. 8d. per 1000 cubic feet. Certain alterations and improvements on the works were ordered.

A meeting of the Committee of Management of the Arbroath Gas Corporation was held last Tuesday evening, when the Auditor's report and balance-sheet for the year ending the 31st of May were submitted. The Manager's annual report was also read. Both reports were ordered to be printed.

The annual meeting of the Shareholders of the Alyth Gas Company was held on Monday, the 7th inst.—Mr. Peterkin presiding. In the report by the Directors on the income and expenditure for the past year, it was recommended that the price of gas be continued at 6s. 8d. per 1000 feet, and that a dividend of 8 per cent. be paid on the 31st of July. It also showed that considerably more gas had been consumed by the community than in any former year. The report was adopted.

It was resolved at the annual general meeting of the Brechin Gaslight Company, which was held on Monday, the 7th inst., to reduce the price of gas from 5s. to 4s. 7d. per 1000 feet. The dividend for the past year was fixed at 17s. 6d. per share, with the addition of 5s. as interest accruing from the Company's reserve-fund, making a total dividend of £1 2s. 6d. per share. With the view of providing funds for carrying out certain improvements upon the gas-works, it was recommended by the Directors to issue 80 new £10 shares, to be offered to the present Shareholders at £15 per share.

The Shareholders of the Crieff Gaslight Company held their annual meeting on Monday, the 7th inst.—Dr. Meikle in the chair. A dividend of 10s. per cent. on the stock of the Company was declared, and the price of gas for the ensuing year was reduced from 6s. 8d. to 6s. 3d. per 1000 feet.

The annual meeting of the Stirling Gas Company was held last Tuesday—Dr. Galbraith in the chair. The report of the Directors was read and adopted, and the usual dividend of 10 per cent. on the original shares

was declared. This may be regarded as 12½ per cent. on a capital of £15,000, or as 6¼ per cent. upon the sum of £30,000, to which the capital was increased a year ago.

In accordance with the recommendation of the Directors, the Shareholders of the Markinch Gaslight Company, at the annual meeting held on Monday last week, declared a dividend of 10 per cent. The price of gas is 5s. 10d. per 1000 feet.

The Kettle, Kettlebridge, and Freuchie Gaslight Company have declared a dividend of 5 per cent. on their last year's profits.

The annual meeting of the Portobello Gas Company was held last Thursday, when a dividend of 6 per cent. was agreed to.

Much excitement exists in the town of Hawick amongst the gas consumers and the Shareholders of the Gas Company, whose annual meeting was held last Friday week. The Directors had recommended in their annual report that the price of gas should be reduced from 4s. 2d. to 3s. 9d. per 1000 feet; but after an exciting discussion, the meeting resolved, by a majority of 45 to 38, to adopt a motion for increasing rather than reducing the price of gas by 5d. per 1000 feet; so that the price is now 4s. 7d. instead of 3s. 9d. per 1000. The interest and excitement now created in reference to the matter will doubtless soon result in another phase of affairs.

The Glasgow pig iron warrant market has been dull during the past week, and prices have further receded. The low price of 40s. was touched on Tuesday, but from that point a slight rally took place; the tone at the close, however, was still flat. Sellers remained on Friday afternoon at 40s. 3d. cash, and buyers at 40s. 2½d. Manufactured iron is unchanged as regards the demand. The annual summer holidays are now nearly on, after six months of comparative idleness, and the prospect is as cheerless as ever.

There is no improvement to report in the coal trade. Business in every department is excessively dull.

Reduction in the Price of Gas in the Metropolis.—The Directors of the Commercial Gas Company have given notice that from Midsummerday the price of their gas has been reduced from 3s. 5d. to 3s. 3d. per 1000 cubic feet.

Halesworth Gas Company.—At the annual meeting of this Company held on the 2nd inst.—Mr. R. B. Bass in the chair—the report of the Directors, recommending the declaration of a dividend of 10 per cent., was adopted.

New Water-Works for Blackrod.—The Local Board of Blackrod have just completed at Wilderswood, half a mile from Horwich Village Water-Works, a system of water supply which will doubtless prove an immense boon to the inhabitants of the township. The works were designed by Mr. Newton, of the firm of Messrs. Cawley, Newton, and Smith, of Manchester, and have been constructed by Mr. C. W. King, of Wigan.

Quality of the Wigan Gas.—At a meeting of the Wigan Gas Visiting Committee, on Wednesday, the 2nd inst., Mr. Newbigging's reports on the quality of the gas were read as follows: June 23rd. I have the honour to report that I tested the quality of the gas at the Wigan Corporation Gas-Works on Saturday last, in accordance with the Act, between the hours of eight and eleven p.m., with the following result:—Illuminating value, 1st experiment, 18·65 sperm candles; 2nd experiment, 19·00; 3rd experiment, 18·84; average, 18·83. Purity: sulphuretted hydrogen, none. The second test was made on the 1st of July, with the subjoined result:—Illuminating value, 1st experiment, 19·07 sperm candles; 2nd experiment, 18·38; 3rd experiment, 19·21; average illuminating power, 18·88. The average of the whole of the trials made during the month of June was 18·97 candles. Purity: sulphuretted hydrogen, none.

Institution of Civil Engineers.—The originality, labour, and ingenuity displayed by the authors of some of the communications submitted to the Society during the past session have led the Council to make the following awards:—Watt Medals and Telford Premiums, for papers read at the ordinary meetings, to G. F. Deacon, for "Street Carriage Way Pavements," and to J. N. Douglass, for "The Electric Light Applied to Lighthouse Illumination." Telford Medals and Telford Premiums to J. B. Mackenzie, for "The Avonmouth Dock," and to A. F. Blandy, for "Dock Gates." Telford Premiums to E. Dobson, for "The Geelong Water Supply, Victoria;" to J. Price, for "Moveable Bridges;" and J. E. Williams, for "The Whitehaven Harbour and Dock Works." The Manby Premium has been adjudged to J. P. Griffith, for "The Improvement of the Bar of Dublin Harbour by Artificial Scour." For papers printed in the Proceedings without being discussed, Watt Medals and Telford Premiums have been bestowed on G. W. Sutcliffe, for "Machinery for the Production and Transmission of Motion," and on E. Sang, for "The Best System of Wheel Teeth;" and Telford Premiums on W. G. Laws, for "The Railway Bridge over the River Tyne at Wylam," and on G. Higgin, for "Experiments on the Filtration of Water." For papers read at the supplemental meetings of Students, Miller Prizes have been conferred on A. C. Hurtzig, for "The Tidal Wave in the River Humber;" R. H. Read, for "The Construction of Locomotive Boilers;" J. C. Mackay, for "The Excavating of a Tunnel in Rock by Hand Labour and by Machinery;" and P. W. Britton, for "The Design and Construction of Wrought-Iron Tied Arches."

Chicago Water-Works.—Mr. De Witt C. Cregier, Engineer of the Chicago Water-Works, has prepared his report for the year ending Dec. 31, 1878. The total quantity of water pumped during 1878, with an allowance of 5¾ per cent. for loss of action in pumps, was 11,145,370,232 gallons. The greatest daily average quantity pumped during 1877 slightly exceeded 32,750,000 gallons. The greatest daily average for a single month during that year was in May—viz., nearly 37,250,000 gallons. The daily average for the past year was a trifle over 30,500,000 gallons, while the greatest daily average for a single month was in November—viz., 38,250,000 gallons. During the year 8526 tons of Lackawanna and 140 tons of Erie coal were used, and the total expenses chargeable to pumping were 69,573 dols. The cost of delivering water per million gallons was 6·24 dols., and the cost of repairs and additions per million gallons 14 dols. The cost of delivery has steadily decreased of late years. In 1870 it was 11·71 dols. per million, and in 1874 it ran up to 12·86 dols., since which time every year has shown a considerable reduction. During 1878 there were manufactured in the shops attached to the works 158 new hydrants and 252 stop-valves, while a large number were repaired. The total expenditure for labour and material in the shops, including the value of the stock in hand on Jan. 1, 1879, was 18,475 dols., and the value of the work done was 22,750 dols.

Hindley Local Board Gas Supply.—At the meeting of the Hindley Local Board, last Tuesday, it was reported that at a meeting of the Gas Committee, held on the 24th ult., the annual report of the Clerk (Mr. S. Holt), dated the 24th of June, 1879, with balance-sheet of gas-works for three months ending March 25, 1878, and twelve months ending March 25, 1879, also a statement for three years of the gas revenue and workings, was read. It was as follows: To the Gas Committee of the Hindley Local Board.—Gentlemen,—Herewith I beg to submit you the annual statement of your gas accounts to March 25, 1879. The Local Government Board require the accounts to be closed on the 25th of March in each year. I have, therefore, made up one set of accounts from Jan. 1, 1878, to March 25, 1878 (three months), to comply with the Local Government Board requirements. In the year's accounts from March 25, 1878, to March 25, 1879, I have shown the odd three months separately, and also taken together the latter account for the whole period of 15 months. The loss is £204, a much smaller loss than we have ever had since the Board took over the gas-works in 1873. The lower price of coal and the increased price of tar and ammoniacal water have improved the credit side of the accounts. The loss since the Board took possession of the works is over £4000, which has been placed to capital account, and adds yearly a sum of, say, £170 to the interest to be paid by this department, which should be cleared off annually, and not be placed to this account. I should be glad to have your instructions, with a view to this being put upon a more satisfactory footing. The charge for water is very heavy. I also enclose you a three years statement, showing coal used, make, average, loss, &c. The make per ton of coal is below the past two years. The total gas sold has gradually gone down during the past three years as follows:—1876, 20,553,000; 1877, 19,022,700; 1878 (three months), 6,998,900; 1878-9 (twelve months), 18,898,100. Decrease in the year 1878-9 from 1876 equal 1,654,900 cubic feet."

Sanitary Institute of Great Britain.—At the annual meeting of the above Institute, held at the Royal Institution, Albemarle Street, on Thursday, the 10th inst.—His Grace the Duke of Northumberland in the chair—an address on "Water Economy" was delivered by Mr. G. J. Symons, F.R.S., in the first part of which he explained the circumstances which combined to render the small areas in the kingdom, on which upwards of 75 inches of rain fall annually, of great national importance. Almost all these districts of heavy rain were districts of hard rocks, of steep slopes, and of sparse population. The first of these conditions ensured the permanency of the physical geography of the district—the rocks being too hard to be washed away—and therefore the permanency of the rainfall; the second lessened evaporation, and sent the water rapidly into the streams or lakes; and the third tended to ensure the purity of the effluent water. Having traced the water from the clouds to the earth, he next considered the effect of soil, crops, inclination of ground, &c., upon the water thus precipitated. After showing the necessity for modifying our customs and laws respecting rivers and watercourses, &c., in conformity with the advance of civilization and the increasing population of the country, he asked whether it was not rather a farce to describe a scheme, the works of which traversed three or four counties, as a "private Bill." The absence of any Government department to watch over our national water supply left the parliamentary committees, to whom these so-called private Bills were referred, in an unsatisfactory position. When nearly all the gathering-grounds in the country had been awarded in perpetuity to some of the towns which at present were the most wealthy and important, we should probably form a department to watch over the remainder. In conclusion, he recommended that the entire administration of streams should be under a single direction, which should see to all questions of drainage, sewerage, canalization, motive power, and water supply. Such new works as were required promptly should only be authorized subject to their reverting to Government in 50 or 100 years. All other hydraulic works should be undertaken, or, at all events, supervised, by a Government department, so as to ensure the greatest possible public benefit, and not merely that of an individual town.

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

2732.—Johnson, J. R., Southampton Buildings, London, "Improvements in gas-engines." July 4, 1879.

2744.—Whyte, G., Northview, N.B., "Improvements in the construction and action of electric lamps or lights, or mechanism connected therewith." July 5, 1879.

2756.—Harrison, F. J., Queen Victoria Street, London, "Improvements in gas-burners for increasing the illuminating power of gas." July 7, 1879.

2768.—Brown, J., Bill Quay, Durham, "Improvements in retort-lids, manhole covers, valves, and such like apparatus." July 7, 1879.

2769.—Newton, H. E., Chancery Lane, London, "Improved means and apparatus for electric lighting." A communication. July 7, 1879.

2801.—Newton, H. E., Chancery Lane, London, "Improvements in water-meters." A communication. July 9, 1879.

2813.—Scaife, R., Moorgate Street, London, "A new or improved method for treating residues from gas-works, such as spent oxides, spent sawdust, spent lime, and all other nitrogenous, sulphurous, and oily and gummy and resinous matters, such as shoddy, waste leather, mungo, old rubber, and other similar substances, in order to obtain valuable extracts, such as sulphur, ammonia, cyanides, and oleic acids." July 10, 1879.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

206.—Barker, G., Birmingham, "Improvements in gasholders or gas-meters." Jan. 18, 1879.

277.—Cohné, S., Gracechurch Street, London, "A new or improved electrode or electric candle for the purpose of lighting by electricity, and effecting the divisibility of the electric light." Jan. 22, 1879.

863.—Abel, C. D., Southampton Buildings, London, "Improvements in electric lamps." A communication. March 4, 1879.

1454.—Bray, G., Leeds, Yorks, "Improvements in street and other lamps and burners; also in means employed for increasing the illuminating power, brilliancy, and steadiness of gas-flames." April 12, 1879.

1676.—Walters, J., and Davies, E., Liverpool, Lancs, "Improvements in and relating to lighting by illuminating gases and apparatus to be employed therefor." April 29, 1879.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

2691.—Redwood, T. B., "Improvements in the manufacture of gas for burning." June 23, 1876.

2691.—Anderson, C., "An improved means or apparatus for connecting and disconnecting gas, water, or other pipes." June 30, 1876.

2712.—Henderson, A. G., "Improvements in gas-meters." July 1, 1876.

PATENTS WHICH HAVE BECOME VOID

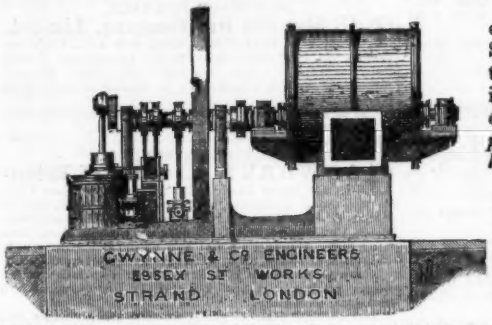
BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £100 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

1880.—Morgan-Brown, W., "An improved apparatus for extracting ammonia in the form of liquid ammonia from crude ammoniacal liquors." June 22, 1872.

1914.—Townsend, J., "Improvements in furnaces or apparatus for obtaining heat or gases from coal or other substances containing carbon." June 25, 1872.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION, TWO MEDALS at the PHILADELPHIA EXHIBITION and TWO MEDALS at the PARIS EXHIBITION, have been AWARDED to GWYNNE & CO. for GAS-EXHAUSTERS, ENGINES, and PUMPS; Also 27 OTHER MEDALS AWARDED at all the GREAT INTERNATIONAL EXHIBITIONS.

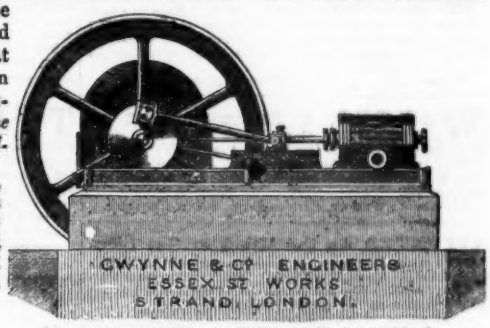
GWYNNE & BEALE'S PATENT GAS-EXHAUSTERS & ENGINES.



EXHAUSTER with Trunk Engine, capable of passing 210,000 cubic feet per hour.

The Judges report on the combined Exhauster and Steam-Engine exhibited at the Philadelphia Exhibition is—"*Reliable compact Machine, well adapted for the purpose intended, of excellent workmanship.*"

GWYNNE & CO. have made the largest and most perfect Gas-Exhausting Machinery in the world, and have completed Exhausters to the extent of 8,000,000 cubic feet passed per hour, of all sizes from 2000 to 210,000 cubic feet per hour.



32,500 EXHAUSTER, with Horizontal Engine combined.

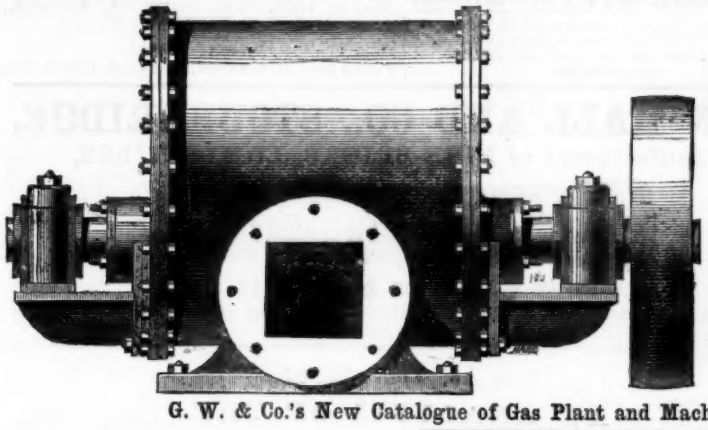
GWYNNE & CO. do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, *but to produce machinery of the very highest quality, and most approved design and workmanship.* The result is that in every instance their work is giving the fullest satisfaction. Numerous testimonials and references can be given to Companies using their Machinery for years past.

Exhausters, with or without Engines combined, can be made to pass the gas WITHOUT OSCILLATION OR VARIATION IN PRESSURE Regulators, Bye-Passes, Stop-Valves, Gas-Valves, Station Governors, and Gas Machinery of all Sizes.

PLEASE ADDRESS IN FULL, **GWYNNE & CO.**, Hydraulic and Gas Engineers,
ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C., ENGLAND.

Gwynne & Co.'s New Catalogue on Gas-Exhausting and other Machinery may be obtained on application at the above Address.

BEALE'S IMPROVED PATENT GAS EXHAUSTERS,



WITH OR WITHOUT
WROUGHT-IRON SPINDLES AND
ENGINES COMBINED.

GEORGE WALLER & CO.,
MAKERS OF
ENGINES, EXHAUSTERS,
INDEX AND DISC GAS-VALVES,
HYDRAULIC MAIN VALVES,
BYE-PASS VALVES,
TAR, LIQUOR, AND OTHER PUMPS,
SCRUBBERS AND PURIFIERS,
CONDENSERS, BOILERS, &c.

G. W. & Co.'s New Catalogue of Gas Plant and Machinery can be had on application.

PHŒNIX ENGINEERING WORKS:
HOLLAND STREET, SOUTHWARK, S.E.

TO GAS ENGINEERS.

D. BRUCE PEEBLES & CO.

Beg to call the attention of Gas Engineers to the fact that the novel and original feature in connection with PEEBLES' SYSTEM OF CONTROLLING THE ACTION OF GAS GOVERNORS is the loading or acting on the Bell by Pneumatic Pressure instead of Weights.

TAY WORKS. BONNINGTON, EDINBURGH.

WANTED, Readers of the NEW Edition, 1879, "Cooking & Heating by Gas;" on Burners, &c. Copies, by post, Threepence, direct from the Author, MAGNUS OHREN, A.I.C.E., Gas-Works, SYDENHAM, S.E.

WANTED, Masonic Votes on behalf of a Child of the late Bro. John Johnson, who was a Subscribing Member of the "Evening Star Lodge," No. 1719, and a Member of the British Association of Gas Managers.

Votes received by Bro. MAGNUS OHREN, Lower Sydenham, KENT, Secretary of the Lodge.

CLERK OF WORKS.

WANTED, by the Sheffield United Gas-light Company, a Practical and Experienced Man to act as CLERK of WORKS in connection with the Building of a Brickwork and Puddle Gasholder-Tank. Preference will be given to a person who has been engaged in carrying out similar work. Applications, with references and age, and stating wages, to be sent in to me on or before the 25th inst.

THOS. ROBERTS, Manager.
Gas Office, Commercial Street, Sheffield,
July 11, 1879.

WANTED, a Situation as Manager or ASSISTANT MANAGER of a Gas-Works on the Continent or Abroad. Thoroughly efficient in every department. Aged 30. Speaks French and Italian. Good testimonials.

Address GAS, care of Advertising Offices, 150, Queen Victoria Street, LONDON, E.C.

WANTED, a small Gas-Works on Lease for Seven or Fourteen years. Annual make from two to six millions. A percentage upon capital to be paid as rent. Advertiser is also open to Purchase small Gas-Works.

Address No. 559, care of Mr. King, 11, Bolt Court, Fleet Street, LONDON, E.C.

TO GAS ENGINEERS.

A Young Engineer, with experience in Gas and General Engineering at home and abroad, desires permanent or temporary work. Thoroughly conversant with the Continental system of Heating Retorts by Furnaces and Recuperators. Also experienced in Tar and Liquor Plant.

Address No. 560, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Vertical 8-in. Pipe Con-denser, having 10 pipes, Tar Box, about 3 feet quare, Scrubber, 7 ft. to 8 ft. high, 4 ft. diameter, Three Purifiers, each 6 ft. by 6 ft. by 3 ft., or 3 ft. 6 in., and Centre Valve for same. Not less than 5 in. connections.

Address J. SMEDLEY, Lea Mills, near DERBY.

TO GAS ENGINEERS AND MANAGERS.

WANTED, a Re-engagement as Fore-man of Retort-Setters or Retort-Setter by Contract or Day, having just left the Beckton Station of The Gaslight and Coke Company. First-class references.

Address J. IREDALE, 4, Lorne Villas, Custom House, VICTORIA DOCKS, E.

WANTED, by the Dumfries Gas Com-missioners, a FOREMAN for the Works, under the Manager.

Applicants must be able to do Smith Work, Engine Work, Plumbing, Gas-Fitting, and Pipe-Laying, to Inspect and Repair Meters, Wet or Dry. Wages from 25s. to 40s. per week, according to ability. Applications, with certificates, to be lodged with WILLIAM MARTIN, Town Clerk to the Commissioners, on or before the 1st of August.

Dumfries, July 11, 1879.

WANTED, a Situation as Assistant to a Gas Engineer. Extensive experience in Construction, both Buildings and Apparatus. Good Draughtsman, and can Level.
Address No. 556, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by the Advertiser, a Situation as UNDER-MANAGER or CLERK in a Gas-Works, the make about 100 millions per annum, where a practical knowledge of Gas Engineering could be gained. Four years in a large rental office. Satisfactory reasons for change. First-class references.
Address G. G., 19, Oxford Street, LEICESTER.

WANTED, a Re-appointment as MANAGER of Gas-Works. Has a large experience in the Erection of Gas Plant. Practically acquainted with all the details of Manufacture and Distribution. Has been Manager of Gas-Works for 13 years. Most excellent testimonials.
Address W. WRIGHT, Barham Road, SOUTH CROYDON.

WANTED, by the Hinckley Gas Company, Limited, a practical Competent MANAGER. (Annual make about 17 millions.) Must understand Gas-Fitting. Gas-Engine and Exhauster in use. Salary about £100 a year, with house, coal, gas, and rates free.
Applications, with qualifications and testimonials, to be sent to the undersigned by the 25th inst.
None need apply whose character for honesty and sobriety will not bear the strictest inquiry. The whole time to be given to the duties.
W. G. FARMER, Chairman.
Hinckley, July 11, 1879.

TO Gas Managers.—If you want Good Heats, try R. Andrews's Principle of Retort-Setting. Estimates given for Building new Benches.
114, Elsby Road West, Shaftesbury Park, LONDON, S.W.

THE Advertiser, late Cashier and Draughtsman to Thomas Piggot and Co., Engineers, Spring Hill, Birmingham, also having had considerable commercial experience, will shortly be open for an Appointment. Can give highest references.
Address H. G. COLLINS, Mayfield Road, Handsworth, BIRMINGHAM.

GAS-METERS.

A Gentleman with a good connection among Gas Companies in the North and Midland Counties, and well acquainted with the business, wishes to Represent a Good Firm in Dry and Wet Gas-Meters. Commission and expenses.
Address A. Z., care of W. H. Bennett, Esq., 22, Great George Street, Westminster, LONDON, S.W.

EXHAUSTER FOR SALE.

FOR SALE, an Engine and Exhauster combined, to pass 7000 feet per hour, together with Boiler, 12 ft. by 4 ft., Boiler Fittings, Connections, Regulator, and Stone Bed.
For particulars, apply to W. T. TEW, Gas-Works, WARWICK.

TO COLLIERY PROPRIETORS, COAL MERCHANTS, AND OTHERS.

THE Directors of the Altoy Gas and Coke Company invite TENDERS for the Supply of 850 Tons of Good GAS COALS, to be delivered, carriage paid, on rails at Altoy Station (L. & S. W. R. Co.), in quantities as under:—

250	Tons during the month of	September,	1879.
300	"	December	"
200	"	February,	1880.
100	"	March,	"
850			

The Coal to be of good quality, free from bats, bind, pyrites, and other refuse.
Tenders to state from what colliery the coals are obtained, Terms of payment, cash at a month.
The Directors do not bind themselves to accept the lowest or any tender.
Tenders to be sent in not later than Monday, July 28, 1879.
H. W. ELLIOTT, Secretary.

THE Gloucester Gas Company, ceasing to manufacture gas at their old works, will have the undermentioned APPARATUS for Sale about the beginning of August, viz.:—
110 Mouthpieces, D-shape, 13 in. by 22 in., with Wrought-Iron Lids, Cross-Bars, Stand, Bridge, and Dip Pipes. Also about 150 feet of D-shape Wrought-Iron Hydraulic Main, size 19 in. by 19 in. 28 Mouthpieces, D-shape, 16 in. by 20 in., with Wrought-Iron Lids, Cross-Bars, Stand, Bridge, and Dip Pipes. Also about 38 ft. of D-shaped Wrought-Iron Hydraulic Main, size 20 in. by 20 in. Annular Condenser, consisting of six Vertical Pipes, 24 in. diameter, 19 ft. high, with three 12 in. Slide-Valves and 12 in. Connections.
Scrubber (round), 5 ft. by 20 ft., with three 12-in. Slide-Valves, and 12 in. Connections.
Exhauster (Jones) to pass about 15,000 feet per hour.
Exhauster (Beales) to pass about 25,000 feet per hour.
Two Vertical Steam-Engines, each about 6-horse power, with Pulleys, and Shafting used for driving the above.
Boiler 14 ft. 6 in. by 3 ft. 6 in., with Centre Tube, and four Galloway Patent Tubes.
4-horse power Horizontal Steam-Engine.
Three 4-in. Pumps, with cranked Shafting and a pair Mitre Wheels.
Set of four Purifiers, 12 ft. by 12 ft. by 4 ft., with 12-in. Centre-Valve (Cockeys), and Connections and Lift complete.
Station-Meter by A. Wright and Co., London, with three 12-in. Slide-Valves, and 12-in. Bye-Pass and Connections, to pass about 25,000 feet per hour.
Gasholder, Double Lift, with Cast-Iron Tank, capacity 37,000 feet.
Gasholder, Double Lift, capacity 100,000 feet.
Gasholder, Double Lift, capacity 240,000 feet.
Two 12-in. Governors, by Wright, London, with 12-in. Valves, Bye-Pass, and Connections.
Two 12-in. four-way faced Valves, by Cockey.
For further information, &c., apply to the undersigned.
R. MORLAND, Engineer.

THE Lisbon Gas Company invite Tenders for the Supply, free on board, in Newcastle, of the quantity of first-class GAS COALS they may require from September 1, 1879, to July 31, 1880. Tenders to be sent to their Offices, in Lisbon, not later than the 29th of July.

TO BE SOLD, Cheap, Three Telescopic GASHOLDERS, two 60 ft. diameter and 20 ft. deep each lift, and one 70 ft. in diameter and 20 ft. deep. Only been in use eight years. May now be seen at work at the Effingham Street Gas-Works, Sheffield.
For price, apply to THOMAS PIGGOTT AND CO., Spring Hill, BIRMINGHAM.

TO GAS ENGINEERS.

THE Directors of the Tewkesbury Gas Company, Limited, invite TENDERS for Condensers, Scrubber, and Purifiers, to be erected at their Works. Plans and specifications may be seen at the Company's Office from Wednesday, July 16, till Wednesday, July 30, by which day tenders must be sent in, addressed to the Secretary of the Company, and marked "Tender for Works."
The Directors do not bind themselves to accept the lowest or any tender.

WIDNES GAS-WORKS.

THE Gas Committee of the Widnes Local Board invite TENDERS for Replating the Roof of a Single-Lift Gasholder, 80 ft. in diameter.
Specification and form of tender may be seen at the Engineer's Office at the above works.
Tenders, endorsed "Gasholder," and addressed to the Chairman of the Gas and Water Committee, to be delivered at the Public Offices, Widnes, not later than the 30th of July.
The Board do not bind themselves to accept the lowest or any tender.
HENRY ROBERTS.
Public Offices, Widnes, July 7, 1879.

THE
IMPERIAL METER CO.,
LIMITED,
(Formerly Walter Ford, at Gray's Inn Road),
KING'S ROAD, ST. PANCRAS,
Manufacturers of THE IMPROVED DRY GAS-METER, THE PATENT WET GAS-METER, Special Meters for Public Lighting, STATION-METERS, Governors, &c.

PURIFIERS FOR SALE.

FOR SALE, price £60.—The Plates forming a Set of Two Purifiers, 12 ft. by 4 ft. 6 in. by 4 ft. deep, together with wrought-iron Covers, Lifting Tackle, Wood Sieves, Hydraulic Valve, and Connections The above are all equal to new, and very handy, requiring little floor space.
Apply to the MANAGER, Gas-Works, STONEHAVEN, N.B.

GOVERNOR FOR SALE.

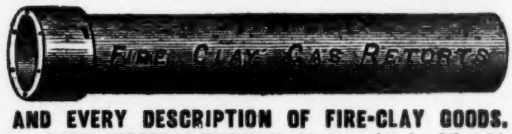
THE Shanklin Gas Company, Limited, have FOR DISPOSAL a nearly new 8-in. Air Vessel Concentric GOVERNOR, with six Ornamental Pillars, 8-in. Four-way Bye-pass Cock with Connections. Makers, Messrs. W. and B. Cowan. To be moved to make room for extensions.
Can be seen and particulars obtained on application to W. SUTHERLAND, Secretary.

FOR SALE BY TENDER.

GAS-WORKS, consisting of Retort- House. Seven Retorts, Purifying-House, Two Purifyers, each 5 ft. square, with Dry Centre-Valve, Meter-House, Station-Meter, and Bye-Pass Valve, Lime and Store Sheds, Condensers, and Gasholder to contain about 5000 cubic feet. Manager's house and offices and about a mile and a half of mains, all of which are in capital condition.
There is a colliery just open within two miles of the works, producing coal of a first-class quality, which will be a great advantage.
The average make of gas is over one million cubic feet per annum, for which 8s. per 1000 is paid, and the consumption is steadily increasing.
For further particulars, apply, by letter, to H. T., 61, Portsdown Road, Maida Vale, LONDON, where tenders are to be sent.

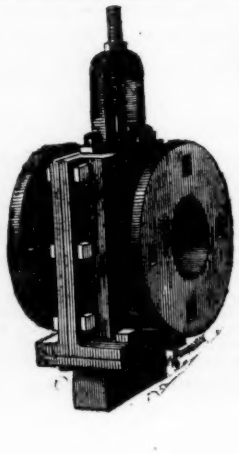
Price 28s., handsomely bound in Morocco, cloth sides, gilt edged and lettered.
THE FIRST VOLUME
OF
KING'S TREATISE
On the Science and Practice of the Manufacture and Distribution of
COAL GAS.
Edited by THOS. NEWBIGGING, C.E., M.Inst.C.E., and W. T. FEWTRELL, F.C.S.
Orders received by
WALTER KING, 11, Bolt Court, Fleet Street, London, E.C.

JOHN HALL AND CO., STOURBRIDGE,
Manufacturers of FIRE-BRICKS, LUMPS, TILES,



AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.
N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

Now ready, price 10s. 6d.,
AN ANALYSIS OF THE
METROPOLITAN GAS COMPANIES ACCOUNTS
For the Year 1878,
(In continuation of the previous Eight Years, 1869—1877,)
COMPILED AND ARRANGED BY JOHN FIELD,
FOR MANY YEARS ACCOUNTANT TO THE LATE IMPERIAL GAS COMPANY.
Can be had of W. KING, Office of "Journal of Gas Lighting," 11, BOLT COURT LONDON, E.C.;
AND OF
EDEN FISHER & CO., Stationers, 50, LOMBARD STREET, LONDON, E.C.



IMPROVED
BRIDGE VALVES
For Regulating the Seal of Hydraulic Mains in Gas-Works.
These Valves are so arranged that, when once adjusted for the proper overflow, they can be closed entirely and opened again *without* altering the adjustment.
B. DONKIN & CO.,
Manufacturers of Gas-Exhausting Machinery, &c.,
BERMONDSEY, LONDON, S.E.

J. & H. ROBUS,

BUILDERS AND CONTRACTORS

FOR THE ERECTION AND REBUILDING OF GAS AND WATER WORKS,

RETORT-SETTING—A SPÉCIALITÉ.

ROBUS'S IMPROVED RETORT-SETTINGS, guaranteed to Carbonize a large amount of Coal with a small per cent. of Fuel.

ESTIMATES GIVEN FOR MAIN-LAYING.

N.B.—All kinds of Fire Goods and Gas Apparatus supplied on the shortest notice.

Address:—J. & H. ROBUS, BELL GREEN, CATFORD, LONDON, S.E.

GAS *v.* ELECTRIC LIGHT.

WIGHAM'S PATENT GAS-BURNERS

FOR

STREET LIGHTING, &c.

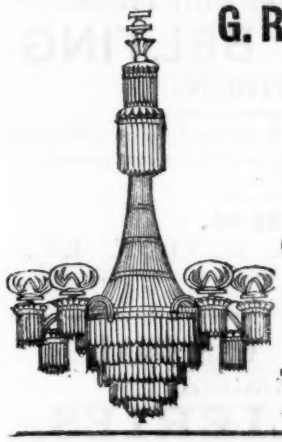
Speaking of these burners, erected on the Thames Embankment by Westminster Bridge, the *Daily News* says:

". . . . . A blaze of light is thrown out, which, in point of efficiency and brilliancy, far surpasses the large gas-lamps lately erected in Waterloo Place, *while even the electric lights are quite thrown into the shade.*"

SOLE MANUFACTURERS:

J. EDMUNDSON & CO., GAS ENGINEERS,

19, GREAT GEORGE STREET, WESTMINSTER, LONDON, S.W.



G. RAINSFORD & SON,

ESTABLISHED 1850,

MANUFACTURERS

OF

CHANDELIERS

AND

GAS-FITTINGS,

SUITABLE FOR

GAS COMPANIES.

70, BROAD STREET,

BIRMINGHAM.

GAS PLANT FOR SALE.

A 10-in. Vertical Pipe Condenser, having 20 Pipes, each 19 ft. high, on Cast-Iron Base Box.

A Scrubber, 16 ft. high 5½ ft. diameter, fitted with thin boards, Self-Acting Liquor Distributor, 10-in. inlet and outlet pipes.

Two Single-Flue Cornish Boilers (new in 1870), each 9½ ft. long, 3 ft. 9 in. diameter; Fire Tube of Low Moor Iron, complete with all Fittings.

All in good working order; removed to make room for larger plant.

For further particulars apply to THOS. TREWHITT, Gas-Works, WEST HARTLEPOOL.

May 8, 1879.

MIDDLESBROUGH-ON-TEES CORPORATION GAS-WORKS.

THE Gas Committee are prepared to receive TENDERS for the Surplus TAR and AMMONIACAL LIQUOR for One or Three years. Quantity about 140,000 Gallons of Tar and 380,000 Gallons of Ammoniacal Liquor per annum, which will be delivered into tanks supplied, by Contractor, at the Works.

Payments to be made monthly, net cash.

Tenders to be addressed to the undersigned by the 22nd of July.

The Gas Committee do not bind themselves to accept the lowest or any tender.

GEORGE BAINBRIDGE, Town Clerk.

Middlesbrough.

CLERK OF WORKS—GAS-WORKS.

THE West Bromwich Improvement Commissioners desire to appoint a CLERK of the WORKS in connection with the Gas-Works about to be built by them. He will be paid a salary of £2 10s. per week, and must enter on his duties on the 18th of August next.

Application, stating age, qualifications, and former appointments, and enclosing three recent original testimonials (which will be returned), must be sent to me at the Town Hall, West Bromwich, on or before the 28th of July inst.

The Commissioners do not bind themselves to make any appointment.

CHAS. H. BAYLEY, Clerk.

Town Hall, West Bromwich, July 2, 1879.

WEST BROMWICH GAS-WORKS.

THE West Bromwich Improvement Commissioners are prepared to receive TENDERS from competent persons for the construction of Two GAS-HOLDER-TANKS, each 102 ft. diameter and 33 ft. deep, together with the foundations for Buildings and Plant, and the preparation of the Site up to the intended ground-level of the Gas-Works.

Duplicate copies of the drawings and specification may be seen, and forms of tender with quantities may be obtained on payment of one guinea (which will be returned in all cases on the receipt of a *bonâ fide* tender on the form supplied), on and after Monday, July 14th, on application to the Engineer, Mr. G. W. Stevenson, 33, Parliament Street, Westminster, S.W., or at the Town Hall, West Bromwich, and sealed tenders, endorsed "Tender for Gas holder-Tanks," must be delivered on or before Saturday, the 26th of July inst., at my Offices in the Town Hall, West Bromwich.

The Gas Committee do not bind themselves to accept the lowest or any tender.

CHAS. H. BAYLEY, Clerk.

Town Hall, West Bromwich, July 2, 1879.

ECONOMY IN THE PRODUCTION OF GAS, AND CARBON DEPOSIT ENTIRELY PREVENTED.

PLUTONIC CEMENT,

FOR JOINTING AND REPAIRING RETORTS AND OVENS *in* ACTION AND *out* OF ACTION.

A Pamphlet on the advantages of the above, with Modes of Application, References, Prices, &c., free by post, from the Sole Manufacturer,

WILLIAM RICHARDSON, Gas and Hydraulic Engineer, CHARLES HENRY STREET, and BISSELL STREET, BIRMINGHAM.

Now Ready, Price One Guinea,

PRECEDENTS IN PRIVATE BILL LEGISLATION

AFFECTING GAS AND WATER UNDERTAKINGS.

COMPILED BY MR. G. W. STEVENSON, C.E., F.G.S.

This Work contains information with regard to the practice of Parliament during the last fourteen years, in regard to most of the points on which differences arise in Opposed Bills for Gas and Water Undertakings, comprising—Authorized share and loan capital, Rates of dividend, Capitalization of profits, Term for the repayment of loans, Instances in which new shares are to be sold by auction and Exceptions to the Standing Order requiring new shares to be sold by auction, The limitation of back dividends, Illuminating power, Purity, Price, Notice before testing, The conditions under which the public supply of gas is regulated, Alteration of mains, Instances in which maps of mains are required, and All cases in which undertakings have been transferred, since 1845 in gas and 1865 in water, from Companies to Local Authorities.

In the Water Precedents will be found, in addition, The rates for a supply for domestic purposes, and the Rates for other than domestic purposes.

LONDON: WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

THE WIGAN COAL & IRON COMPANY,

LIMITED,

DISTRICT OFFICE: 97, NEW STREET, BIRMINGHAM; AGENT: W. M'GOWAN,

Supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, &c.

N.B.—The Wigan Coal and Iron Company, Limited, are exclusive owners of the well-known HAIGH HALL AND KIRKLESS HALL GAS COAL COLLIERIES.

SWANWICK CANNEL.

Illuminating power, 24 candles. Good Coke, 11½ cwt. to the ton.

For analysis, prices, and references, apply to

H. BOAM, Litchurch Villa, DERBY.

TO GAS COMPANIES.

GEORGE McKAIG,
MANUFACTURER OF
GAS-PURIFYING WOOD SIEVES,
153, CLEVELAND STREET,
DONCASTER.

It requires but one trial to prove the Superior Make, Strength, and Durability of these Sieves.

CARRIAGE PAID.

E. & W. H. HALEY,
IRONFOUNDERS & MAKERS OF
CAST-IRON PIPES
FOR
GAS, WATER, & STEAM.

LISTER HILLS FOUNDRY,
BRADFORD, YORKSHIRE.

TO MAKERS OF SULPHATE OF AMMONIA AND BUYERS OR SELLERS OF GAS LIQUOR.

F. SUTTON & CO., Norwich, are now prepared to Supply a Set of Apparatus with Standard Test Solutions for the rapid and accurate analysis of Gas Liquor, which can be used by any intelligent workman, so as to show the actual amount of Sulphate which can be got out of any sample of liquor in a few minutes, without any of the annoyance arising from saturation with acid, &c. Tables are also given, showing the quantity of acid of various strengths required for any given liquor, the accurate ounce-strength and percentage of pure ammonia, &c. Price of the set, with full direction and table (copyright), with materials sufficient for fifty analyses, £4 4s.

Post orders or cheques to be made payable to F. SUTTON AND CO., Manufacturing Chemists, NORWICH, who also supply every description of Standard Solutions for Volumetric Analysis of Waters, Beers, Manures, &c., of guaranteed accuracy.

M. DAVIS & CO., 27, Wellclose Square, LONDON, E.,
COMMERCIAL GLASS WORKS.

BEST OPAL SHEET GLASS, IN CASES OF 200 FEET.

150 Y	7d. per foot.	26 Y	11d. per foot.
21 Y	9d. ,,	32 Y	1s. 3d. ,,

Enamelled Sheet Glass, Flint and Opal, 1s. 2d. Coloured Glass and Opal, 1s. 6d. to 2s. 6d. per foot.

GAS GLASSES OF ALL DESCRIPTIONS ON HAND; SPECIAL PRICES FOR QUANTITIES.

R. DEMPSTER AND SON'S
WOOD SIEVES FOR PURIFIERS,

WITH TAPER OR PARALLEL BARS,
MADE BY SPECIAL MACHINERY.
SCRUBBERS FILLED WITH BOARDS,
On our approved principle, for the extraction of Ammonia.
Prices on application. References to First-Class Engineers.
ROSE MOUNT IRON-WORKS,
ELLAND, NEAR HALIFAX.
LONDON OFFICES: 2, SUFFOLK LANE, CANNON STREET, E.C.

TRADE MARK.

"VICTORIA,"
The Cheapest and Best
LEATHER BELTING
IN LONDON.

The Leather is of the Best Possible Quality, and English Oak Tanned.
Sample Orders of over £5, Carriage Paid to nearest Railway Station.
Is Manufactured expressly for
J. C. R. OKES,
39, QUEEN VICTORIA STREET, LONDON, E.C.,
And can only be obtained from him or his Agents.
PRICES ON APPLICATION.

GAS COAL. GAS COAL. GAS COAL.
WELLS, BIRCH, RYDE, and CO., Limited,
HOYLAND SILKSTONE COLLIERIES,
Near BARNSLEY.

This Company is now in a position to raise **2000 tons per day of REAL OLD SILKSTONE GAS COAL.**
"The quality of this Coal for Gas purposes, if equalled, is not excelled by any on record, and the Coke competes successfully with best Durham."—See *Mining Journal*, Aug. 11, 1877.
Prices quoted to any Railway Station, or F.O.B. Hull, Grimsby, Goole, Keadby, Liverpool, and Fleetwood.
Full particulars will be sent on application to above address.

IMPROVED
COMPENSATING GAS-METER.
HUNT'S PATENT.

This Meter supplies a want long felt, by putting an end to the loss sustained by Gas Companies through the overworking of their Meters.

These Meters can now be supplied in either TIN-PLATE or CAST-IRON CASES, and OLD METERS converted to this plan. GAS COMPANIES and CORPORATIONS will find it to THEIR ADVANTAGE to adopt these Meters.

EXTRACTS FROM REPORTS.

"I am able to report that the Meters have given in each test most satisfactory results."—*Mr. H. Sporne, City of London Meter Inspector.*
"I consider the arrangement is a great improvement upon the Meters in present general use."—*Mr. T. Jackson, Meter Inspector, Birmingham.*
"I would observe from the results of my testings that the Meters are a great improvement on the ordinary Wet Meters in general use."—*Mr. H. Airey, Meter Inspector to the Metropolitan Board of Works.*

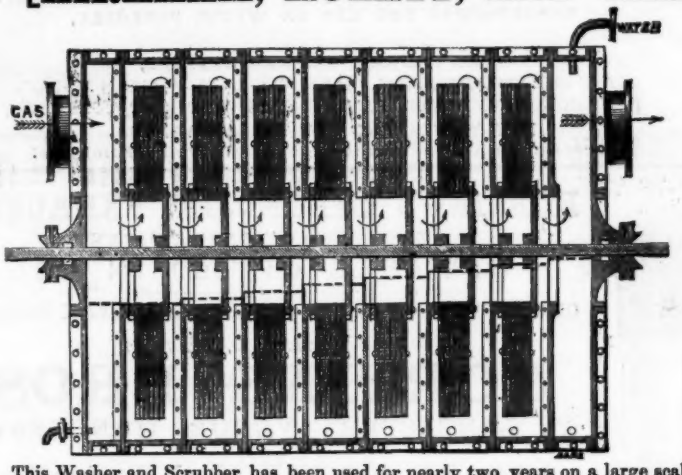
COPIES OF REPORTS SENT ON APPLICATION.

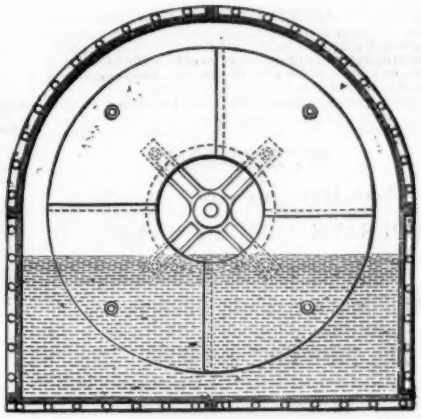
MANUFACTURED BY
JOHN BENT & SON,
WET AND DRY GAS-METER AND GAS APPARATUS MANUFACTURERS,
BELL BARN ROAD, BIRMINGHAM.
Established 1830.

THE

"STANDARD" WASHER & SCRUBBER.

[KIRKHAM, HULETT, AND CHANDLER'S PATENT.]





This Washer and Scrubber has been used for nearly two years on a large scale at the Works of The Gaslight and Coke Company, Bromley-by-Bow, at which station there are now several in operation and in course of construction. There is also one in use at the Pancras Station, King's Cross, of the same Company, which is purifying 1,500,000 cubic feet of gas per day. At the Gas-Works of the Corporation of Leeds, a large one has been erected, which is giving complete satisfaction. The Special Merits of this Washer are as follows:—

That it is a very effective Condenser, so that it is not absolutely necessary to reduce the temperature of the gas to 60°, or thereabouts, to make the Washer effective. That the distribution of the liquor is made with unerring regularity. That it occupies very small space, so that it can be, at little expense, effectually protected from extreme changes of the weather. That the considerable expense of Coke or Wood, or other Scrubbing Material, is entirely saved, and that the great nuisance and cost of from time to time replacing the Scrubbing Material is avoided. That, by the revolution of the discs, the quantity of water carried up by them, and tending continuously to fall, exposes a very large amount of fresh wetted surface to contact with the gas. That it is particularly adapted for Gas-Works where Sulphate of Ammonia is manufactured. That it is much cheaper than any other Scrubber that will do the same amount of work effectually. That it is the only Washer suitable for purifying Gas from all its impurities by solution. That it works with a minimum of pressure. That it takes out every trace of Ammonia from the Gas in once traversing the machine. That it requires very little outlay for foundations.

The following Testimonials show the opinion of eminent Engineers as to the capabilities of the Washer:—

D. HULETT, Esq. *The Gaslight and Coke Company, Bromley-by-Bow, May 3, 1877.*

Dear Sir,—In answer to your inquiries respecting the results of the working of your Patent Washer, I beg to state that I find it a very efficient machine. I have had it in operation for some time, and passed gas through it continuously at the rate of 100,000 cubic feet per hour, and obtained from it 11 gallons of 10 oz. liquor per ton of coal carbonized—results which appear to me very satisfactory for so small a Washer. It works very smoothly, taking but little power, and giving no pressure. I have it still in operation, and am perfectly satisfied with its working.

I am, dear Sir, yours truly, (Signed) W. B. WRIGHT.

Messrs. KIRKHAM, HULETT, and CHANDLER. *The Leeds Corporation Gas-Works, York Street, Leeds, Dec. 6, 1878.*

Gentlemen,—The Scrubber-Washer erected by you at these works, and which has been in use for six months, has proved to be, so far as we have been able to test it, thoroughly efficient. We are at present making 32,000 feet of gas per hour, and are entirely dependent on this apparatus for the removal of Ammonia, and the **Gas is perfectly free from that impurity in the sixth chamber,** so that four chambers remain to deal with an increasing make of gas. Owing to insufficient condensers, the gas was in the summer admitted to the Scrubber at a temperature of 70°, but was reduced therein to 61°, or that of the atmosphere. The volutes are driven at the rate of four revolutions per minute, and, working at that speed, there is not the slightest difference between the inlet and the outlet pressure. Clean water supplied at the rate of 10 gallons per ton of coal carbonized is converted into liquor of from 10 oz. to 13 oz. strength **in once traversing the vessel.** The apparatus is extremely simple and compact, occupies but little space, and requires no foundation. I shall be surprised if it does not eventually become extremely popular.

I am, Gentlemen, yours faithfully, (Signed) HENRY WOODALL, Engineer.

Messrs. KIRKHAM, HULETT, and CHANDLER. *The Gaslight and Coke Company, York Road, King's Cross, Jan. 14, 1879.*

Gentlemen,—In reply to your inquiry, I am pleased to say, the Washer which was put in action at this station in October last has quite fulfilled my expectations, as it confirms the experiments I made in May last with the smaller machine. Working at four revolutions per minute, **it takes out every particle of Ammonia,** while purifying more Gas than it was intended to do. I enclose particulars of a fortnight's working during our heaviest make, by which you will see that it yields the full quantity and strength of liquor, and works with little pressure. I am therefore quite satisfied with the machine, and trust it may meet with the success it deserves.—I remain, &c. (Signed) JOHN CLARK.

The following Table shows the results of the working of one of these Washers, lately erected to purify 60,000 feet of Gas per Hour, at the St. Pancras Station of The Gaslight and Coke Company:—

1879.	Nos. of the Divisions and Strength of Liquor in each.										Water used per Ton of Coals.	Gas Purified per Hour, Cubic Feet.	Ammonia on Outlet.	Temperature.			Pressures.		Revolutions per Minute.
	1	2	3	4	5	6	7	8	9	10				Inlet.	Outlet.	Atmosphere.	Inlet, Inches.	Outlet, Inches.	
	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.									
January 1	8½	6¾	5	3½	2½	1½	¾	¼	0	0	10 Gallons.	52,000	Nil.	77°	73°	48°	24	23	7½
,, 2	8¾	7	6	4½	3¼	2½	1¼	⅜	⅛	0	10 ,,	57,000	Nil.	73°	66°	32°	21¾	20½	4
,, 3	9½	8	6	3¾	3	2½	1½	⅜	⅛	0	10 ,,	60,000	Nil.	75°	68°	40°	23½	22	4
,, 4	9¾	7¾	6¼	4¼	3¼	2¼	1¼	⅜	⅛	0	10 ,,	65,000	Nil.	74°	68°	33°	24	22½	5
,, 5	9½	7	6	4	3	2¼	1½	1	⅛	0	10 ,,	34,000	Nil.	77°	68°	35°	14½	14	3
,, 6	9¼	7¼	6¼	4¼	3	2¼	1½	1	¼	0	10 ,,	63,000	Nil.	72°	66°	27°	24	22½	4½
,, 7	11	9	7	5¼	3¾	3	1¾	1½	⅜	0	10 ,,	59,000	Nil.	74°	66°	31°	25	23½	5
,, 8	9½	7½	6	4¼	3	2	1	¼	⅛	0	10 ,,	78,000	Nil.	73°	61°	31°	28	26½	4¼
,, 9	11	9	7	5	3¾	2½	1¼	1	⅜	0	10 ,,	82,000	Nil.	74°	67°	33°	27½	25½	5
,, 10	10¾	8½	6¾	5	3½	2½	1½	1	⅜	0	10 ,,	66,000	Nil.	76°	64°	28°	28½	27	5
,, 11	12½	10	7¾	5¾	4¼	3½	1¾	1¼	⅜	0	10 ,,	61,000	Nil.	73°	64°	27°	28¾	25½	5
,, 12	11	8¾	6¾	—	—	—	1¼	¾	¼	0	10 ,,	39,000	Nil.	74°	64°	27°	26½	25½	5
,, 13	13	10¾	8¼	6	4¾	3½	2	1½	⅜	0	10 ,,	78,000	Nil.	73°	65°	42°	28	26	5

Messrs. KIRKHAM, HULETT, and CHANDLER. *Corporation of Birmingham, Gas Department, Saltley Works, May 23, 1879.*

Gentlemen,—I beg to enclose you a copy of the results of the tests which, by the kind permission of the Engineer, Mr. Clark, I made on the 6th of March last, of the working of one of your "Standard" Washers and Scrubbers at the St. Pancras Station of The Gaslight and Coke Company, and I am of opinion that, for an apparatus occupying so small a space, they are exceedingly satisfactory.—Yours truly, HENRY HACK, Engineer.

Working Results obtained from KIRKHAM, HULETT, *and* CHANDLER'S *Patent "Standard" Washer and Scrubber at the St. Pancras Station of The Gaslight and Coke Company, London, March 6, 1879.*

Gas passing per Hour, Cubic Feet.	—	Impurities in Gas per 100 Cubic Feet.			Temperature.		Pressure in Inches.	Revolution of Apparatus per Minute.	—	No. of Divisions and Strength of Liquor.										Water Used during Experiment. Gallons.
		SH_2	CO_2.	Grains. NH_3.	Washer.	Air.				—	—	—	—	—	—	—	—	—	—	
64,000 {	Inlet	2·00	2·00	158·8	72	57	21	} 4½ {	Twaddel deg. at 60°	5·3	4·9	2·85	2·35	1·7	1·05	0·6	0·3	0·15	0·1	} 63
	Outlet	1·50	1·50	0·8	68	57	20	}	Acid, ounces. . .	11·0	8·4	6·3	4·5	2·7	1·7	1·3	0·7	0·3	—	

WASHER-SCRUBBERS OF THIS PATENT ARE IN COURSE OF CONSTRUCTION FOR BECKTON, BRADFORD, GREENWICH, WOOLWICH, AND SEVERAL OTHER GAS-WORKS.

For further particulars and testimonials, address

Messrs. KIRKHAM & HERSEY, GAS ENGINEERS, 21, ABINGDON STREET, WESTMINSTER.

WANTED, by Samuel Thompson & Co., Colliery Office, Lancaster, APPLICATION for PRICES from Gas Managers who are prepared to receive Tenders for GAS COAL or CANNEL.

John Leigh, Esq., M.R.C.S., F.C.S., &c., &c., in his analytical report of S. T. & Co.'s Coal, says: "It is remarkable for its purity, I have scarcely ever examined a Coal containing so small a quantity of ash, and when Cannel of the best description is scarce, it may well replace this material."

HENRY LYON (14 years Engineer and Manager of the largest of the Manchester Corporation Gas-Works) Mechanical and Consulting Gas Engineer, reports upon the condition and value of Gas-Works, supplies plans and specifications of all Apparatus appertaining to Gas-Works, and re-models existing Works.

Address Brooklyn, near Halliwell Lane, Cheetham Hill Road, MANCHESTER.

W. LIDDALL,

Public Accountant,

MOORGATE STREET CHAMBERS,

GREAT SWAN ALLEY,

MOORGATE STREET, E.C.

Mr. ROBERT DEMPSTER,

CONSULTING GAS ENGINEER,

ELLAND, near HALIFAX,

May be consulted on all matters connected with Valuations, Arbitrations, and Parliamentary Applications connected with Gas-Works. Having been engaged on extensive Arbitration Cases, which, combined with his experience in Construction and Contracting, his knowledge of Engineering and Valuations is both extensive and reliable.

ALFRED LASS, F.I.Accts.,

SPECIAL ACCOUNTANT FOR GAS AND WATER UNDERTAKINGS,

30, GRACECHURCH STREET, LONDON.

Accounts Analyzed and Statistics Prepared for Parliamentary Proceedings, Arbitrations, &c.

The Forms of Account, which have been specially designed by Mr. Lass to meet the requirements of the Gas-Works Clauses Amendment Act, 1871, are now in use by many Gas Companies, Corporations, and Local Boards.

JOHN ROMANS, C.E., F.G.S.E.,

CONSULTING GAS ENGINEER

AND

CANNEL COAL FACTOR,

30, St. Andrew Square, EDINBURGH.

Plans and Estimates furnished; Gas-Works, Apparatus, Pipes, Machinery, Fire Goods, &c., supplied, or Attested and Shipped for Exportation.

GAS-WORKS TAKEN ON LEASE.

MR. ROMANS has for upwards of 30 years been practically engaged in the Manufacture of Gas, and has, by extensive experiments, ascertained that by JUDICIOUS INTERMIXTURE of the lighter with the heavier gases, much of the rich Hydrocarbons CAN BE SAVED, which otherwise ARE LOST, during the process of manufacture. He is therefore enabled to give advice to those who favour him with their orders for Cannel, as to the class which will secure for their standard of illuminating power the HIGHEST ADVANTAGEOUS RESULTS.

ANALYSIS AND PRICES FORWARDED ON APPLICATION.

W. C. HOLMES & Co.,

ENGINEERS AND CONTRACTORS

FOR

GAS AND WATER-WORKS,

HUDDERSFIELD.

REFERENCES TO UPWARDS OF 400 WORKS.

TO ENGINEERS & MANAGERS.

CLIFTON'S PATENT BARROW

Is acknowledged to be the best in the market; made out of Sheet or Flat Bar Iron.

For particulars apply to the Sole Makers,

THORNELOE & COMPANY,

ENGINEERS AND CONTRACTORS,

57, BARBICAN, LONDON, E.C.

THE

THAMES BANK IRON COMPANY,

OLD BARGE WHARF, UPPER GROUND STREET, LONDON, S.E.,

SUPPLY FROM STOCK

CAST-IRON RETORTS AND ALL KINDS OF GAS-WORKS APPARATUS,

SOCKET-PIPES FOR GAS OR WATER PURPOSES,

FLANGE-PIPES FOR STEAM,

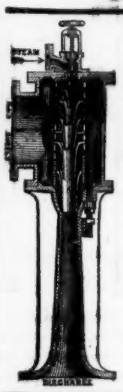
RAIN-WATER PIPES AND GUTTERS,

HOT-WATER BOILERS, PIPES, AND CONNECTIONS,

LAMP-COLUMNS, LAMPS, LAMP-FRAMES, WROUGHT TUBES, &c.,

HOT WATER AND HOT AIR APPARATUS,

Erected complete on the most Improved Principles.



KÖRTING'S STEAM-JET EXHAUSTER.

IMPROVED CLELAND'S PATENT.

UPWARDS OF 300 IN USE.

CLELAND'S SLOW-SPEED CONDENSER & STEAM SCRUBBER.

FOR PARTICULARS, APPLY TO

KÖRTING BROS.,

17, LANCASTER AVENUE, MANCHESTER,

OR TO

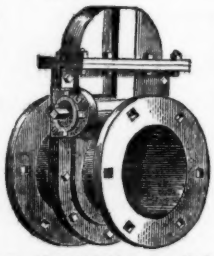
GERALD J. TUPP, Creek Engine-Works, Middle Mall, Hammersmith, London, W.

SOLE AGENT FOR ENGLAND AND WALES.

B. DONKIN & Co.'S

IMPROVED GAS-VALVES

WITH WROUGHT-IRON PINIONS.



List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.

These Valves are proved on both sides to 30 lbs. on the square inch before leaving the works, and are kept in stock.

In ordering Valves, please state whether required for under or above ground, and if to be with flanges or spigots and sockets cast on, or with separate spigot and socket pieces.

ALSO SOLE MAKERS OF

J. BEALE'S NEW PATENT GAS EXHAUSTERS,

AND MAKERS OF

STEAM-ENGINES FOR DRIVING GAS EXHAUSTERS,

VALVES FOR AMMONIACAL LIQUOR,

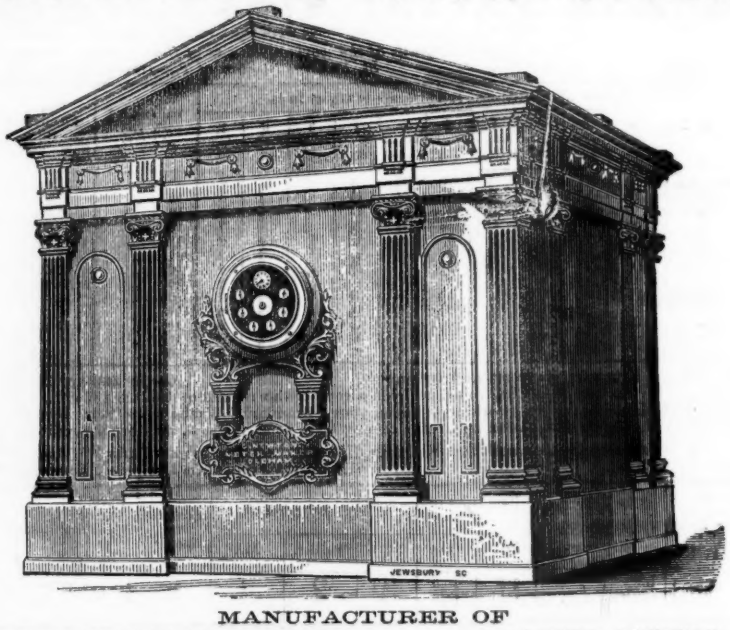
IMPROVED BRIDGE VALVES FOR REGULATING THE SEAL IN HYDRAULIC MAINS,

BYE-PASS VALVES, SCREW WATER-VALVES, &c.

B. DONKIN & CO., 55a **BLUE ANCHOR ROAD, BERMONDSEY, LONDON, S.E.**

GEORGE NEWTON,

UNION STREET WEST, OLDHAM,



MANUFACTURER OF

SQUARE STATION-METERS, with PLANED JOINTS;

ROUND STATION-METERS, WITH CAST-IRON STANDS;

WET AND DRY CONSUMERS GAS-METERS, GOVERNORS, &c.

F. & C. OSLER,

45, OXFORD STREET, LONDON, W.

MANUFACTORY AND SHOW-ROOMS:

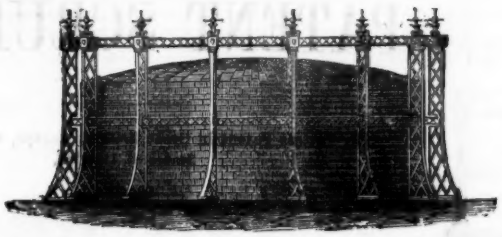
BROAD STREET, BIRMINGHAM.

ESTABLISHED 1807.

MANUFACTURERS OF CRYSTAL GLASS CHANDELIERS, WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.

TABLE GLASS OF ALL KINDS.

CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.



THE HORSELEY COMPANY,

LIMITED,

TIPTON, STAFFORDSHIRE.

LONDON OFFICE:

6, WESTMINSTER CHAMBERS, VICTORIA STREET,

GAS ENGINEERS, IRONFOUNDERS, &c.,

MANUFACTURERS OF

GASHOLDERS, WROUGHT AND CAST IRON TANKS, CONDENSERS, PURIFIERS, SCRUBBERS, MAINS, RETORT-LIDS, PLAIN AND DISHED LAMP-POSTS, PIPES,

AND ALL REQUISITES FOR EITHER

GAS OR WATER WORKS;

ALSO

MAKERS OF ROOFS, BRIDGES, &c.

S. OWENS & CO.,

WHITEFRIARS STREET, LONDON, E.C.,

HYDRAULIC ENGINEERS,

AND MANUFACTURERS OF

PUMPING MACHINERY of every Description.

SOLE LICENSEES AND MANUFACTURERS FOR GREAT BRITAIN OF

BLAKE'S PATENT STEAM-PUMPS,

More than 10,000 in use,

ESPECIALLY ADAPTED FOR USE IN GAS AND CHEMICAL WORKS, FOR PUMPING TAR, WATER, AMMONIACAL LIQUOR, ACIDS, &c.

The following are some of the prominent advantages of the BLAKE PUMP:—

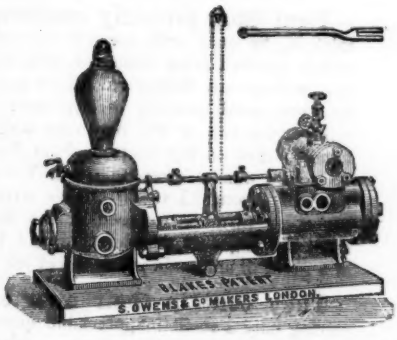
It will start at any point of stroke.

It has no dead point.

It works fast or slow, with the same certainty of action.

It is economical. Has a lead on the slide-valve.

It is compact and durable.



It is interchangeable in all its working parts.

It will deliver more water than any other pump.

It is made of best materials in the most workmanlike manner.

Can be worked at 20 strokes per hour, or 200 strokes per minute.

This Illustration represents Boiler-Feed Pumps, Sizes Nos. 1, 2, and 3, with Hand Lever for working Pump when Steam is not available.

SOLE MANUFACTURERS OF

MANN & OWENS

IMPROVED PATENT GAS-VALVES.

PRICED LISTS AND FULL PARTICULARS FURNISHED ON APPLICATION.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,

5, NORFOLK STREET, MANCHESTER.

Established 1799.

ROBERTSONS & CO.,

TWEED IRON-WORKS,

BERWICK-UPON-TWEED.

Makers of Socket, Flange, and Hot-Water Pipes, Tank-Plates, Lamp-Posts, Columns, Girders, and Gas and other Castings.

THOMAS CARR & SON,

MANUFACTURERS OF

FIRE-BRICKS, LUMPS, TILES, RETORTS, &c.,

COTSWOOD FIRE-BRICK WORKS, SCOTSWOOD-ON-TYNE.

Also Makers of all kinds of Common Building Bricks, and of Pressed White and Red Bricks for Facing.

BIRTLEY IRON WORKS,

CHESTER-LE-STREET, DURHAM.

Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.

Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

Agent in London, Mr. J. Marwarine, 161 Cannon Street, E.C.

JAMES OAKES & CO.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

WENLOCK IRON WHARF, 21 & 22, WHARF ROAD, CITY ROAD, LONDON, N.,

Manufacture and keep in stock at their works (also a large stock in London) PIPES and CONNECTIONS 1½ to 48 inches in diameter; and make to order Retorts, Purifiers, and Tanks, with or without planed joints, Columns, Girders, Special Castings, required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Syphons and Covers are joint-faced if required, doing away with millboard and iron boring, or Syphons made without Covers, a socket being cast on and fitted with a small plug about 6 inches in diameter with lead joint. In either way preventing leakage.

THE

SILICA FIRE-BRICK CO.,

OUGHTIBRIDGE

Near SHEFFIELD,

Manufacturers of THE ORIGINAL SILICA OR DINAS FIRE-BRICKS. Specially adapted for Gas-Retort Furnaces and for Siemens's Gas-Furnaces. Shipments promptly executed to London, Liverpool, Hull, Grimsby, &c.

TROTTER, HAINES, & CORBETT,

BRETTELL'S ESTATE

FIRE CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASS-HOUSE FURNACE & BLAST-FURNACE BRICKS LUMPS, TILES, and every description of FIRE-BRICK.

Proprietors of

BEST GLASS-HOUSE POT and CRUCIBLE CLAYS.

Successors to

E. BAKER AND CO., LATE BRIERLEY HILL, STAFFORDSHIRE.

HARPER & MOORES,

PROPRIETORS OF THE

BEST STOURBRIDGE CLAYS,

STOURBRIDGE.

Manufacturers of all Descriptions of

BEST STOURBRIDGE FIRE-BRICKS, LUMPS AND CLAY RETORTS

Of all Dimensions for Gas-Works,

GLASS-HOUSE POTS & CRUCIBLES

ESTABLISHED 1836.

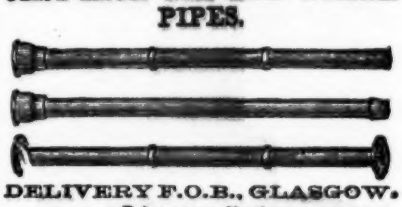
The Highest Award was obtained by H. & M., at the Philadelphia Exhibition, 1876, for Superior Quality of Manufacture. SILVER MEDAL, PARIS, 1878.

GAS AND WATER PIPES.

WILLIAM MACLEOD & CO.,

30, ST. ENOCH SQUARE, GLASGOW.

CAST-IRON GAS AND WATER PIPES.



DELIVERY F.O.B., GLASGOW.

Prices on application.

C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the important results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

Fifty million cubic feet of gas per 24 hours are purified from ammonia by these Patent Scrubbers in a winter's day in the gas-works of London, where the purity of gas supply is the highest in the world, under the chemical restrictions of the Board of Trade.

Generally, wherever a high standard of purification is maintained in the chief cities and towns of the British Provinces and of Europe, these Scrubbers have become established.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

They contain their own engine power, requiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

WILLIAM SUGG'S
IMPROVED SYSTEM OF STREET LIGHTING,

SUITABLE FOR EITHER COMMON OR CANNEL GAS.

Results obtained in Illuminating Power from WILLIAM SUGG'S 200-candle Burners with Cannel and Common Gas.

Burner used.	Variety of Gas.	Cubic feet of Gas burnt per hour.	Illuminating Power in Sperm Candles burning 120 grains per hour.	Number of Candles to which every cubic foot of Gas burnt is equivalent.
Sugg Burner	Common 16-candle ..	53·4	228	4·25
Do.	Cannel 19-candle ..	47·3	252	4·76

Joint experiment by—

CHARLES HEISCH, Superintending Gas Examiner to the Corporation of London.

T. N. KIRKHAM, M.I.C.E., F.C.S.

C. MEYMOTT TIDY, M.A., M.B., Professor of Chemistry and of Forensic Medicine at the London Hospital, Medical Officer of Health for Islington, and late Deputy Medical Officer of Health for the City of London.

The Illuminating power of the gas made by this Company, on the 9th inst., was 22·7 standard sperm candles for a consumption of 5 cubic feet per hour, in a Sugg's No. 7 steatite bat's-wing burner. On the same day the following results were obtained from two of Sugg's large new Argand Burners:—

FIRST EXPERIMENT.

Burner: Sugg's Argand, with two concentric flames.

Consumption per hour . . . . . 22·2 cubic feet.
Illuminating power . . . . . 103·7 candles.
or 4·67 candles per foot of gas.

SECOND EXPERIMENT.

Burner: Sugg's Argand, with three concentric flames.

Consumption per hour . . . . . 40·8 cubic feet.
Illuminating power . . . . . 208·8 candles.
or 5·12 candles per foot of gas.

I have reason to believe that these are as high, if not the highest results yet obtained per foot of gas from these burners.

(Signed) WILLIAM KING,
Liverpool United Gaslight Company,
Engineer's Office, Duke Street.

Liverpool, April 16, 1879.

[See JOURNAL OF GAS LIGHTING, April 22, 1879.]

"Sugg's 200-candle burner, with 42·09 cubic feet of 20·85-candle gas, gave an illuminating power of **231·56** candles."

"Same quality of gas as used at Westminster Bridge, and Waterloo Place, Regent Street."

(Signed) A. C. M'MINN,
Engineer to The Gaslight and Coke Company,
Kensal Green Station.

June 16, 1879.

SUGG'S ARGAND WITH THREE CONCENTRIC RINGS.

Illuminating Power of Gas.	Standard of Comparison.	Gas Consumed per Hour. Cubic Feet.	Illuminating Power.	Illuminating Power per Cubic Foot.
21 Candles	5-ft. London Burner..	45	220·5	4·9
		43	210·0	4·88

(Signed) J. R. FRITH,
Engineer, Runcorn Gas Company.

Glasgow Herald, April 25, 1879—

"The light exhibited last night" (Sugg's 200-candle Burner and Lantern) "was equal to 360 Candles—more than double that given by the old lamps, while the consumption of gas was exactly the same,—40 cubic feet per hour."

Major Dresser, Editor of the *American Gaslight Journal*, writes that—

"With 30 cubic feet of cannel gas I obtained 196·4 candles."

NOTICE.—Notwithstanding a number of statements which have been repeated in the public journals, that burners by other makers have surpassed these results, the reports of comparative experiments from which the above extracts have been copied conclusively prove that **the "Sugg" Burners give over 30 per cent. of Illuminating Power more than can be obtained from any other burners with the like quantity of gas.**

PRICES AND PARTICULARS ON APPLICATION TO

WILLIAM SUGG,
GAS ENGINEER,
VINCENT WORKS, WESTMINSTER, S.W.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

198, ST. VINCENT STREET, GLASGOW.

SHOTT'S BOGHEAD.

HARTHILL CANNEL

Yields 14,920 cubic feet of 40·62-candle gas per ton.

THRASHBUSH CANNEL

12,580 cubic feet of 40·22-candle gas per ton, and 9 cwts. of good coke.

LOTHIAN'S CANNEL

Yields 13,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL

Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash. This cannel is almost free from sulphur.

OLD WEMYSS CANNEL

Yields 13,200 cubic feet of 32·5-candle gas per ton.

Prices and full analyses on application at above address, or from WHEELHOUSE, FERGUSSON AND Co., 21, Lime Street, London, E.C.

GAS COAL.

THE MIRFIELD COAL COMPANY

are supplying GAS COAL of the best quality on trucks at their siding. This Coal contains 10 per cent. of Cannel, and, as analyzed by Mr. James Paterson, of Warrington, yields 12,600 *cubic feet of* 16·67 *candle gas, with* 1450 *lbs. of good Coke, per ton.* Ash in Coke, 1·88.

Apply to the MIRFIELD COLLIERY, Mirfield, NORMANTON.
London Agents: SMITH BROS., 58, THROGMORTON ST., E.C.

THE BROUGHTON COAL COMPANY,

COLLIERIES, NEAR WREXHAM,

Are prepared to Supply their excellent GAS COAL on very favourable terms.

This Coal yields more than 10,000 cubic feet per Ton of gas of good quality, *in practical working on the large scale.*

A large purchaser reports the coke to be clear, of a quality rarely equalled in the retort-furnace, and much liked by the stokers.

HEBBURN MAIN GAS COAL.

This Coal is now highly approved of for gas making, and yields over 10,000 feet per ton of 15-candle gas, and about 14 cwt. coke.

For references and prices, either f. o. b. or by rail, apply to

W. RICHARDSON,

29, QUAYSIDE, NEWCASTLE-ON-TYNE.

GAS COAL.

POPE & PEARSON, LIMITED, have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles;* or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

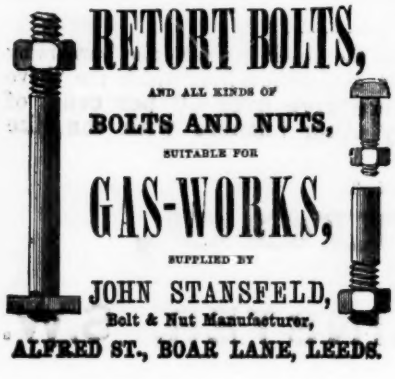
For further particulars, apply to POPE AND PEARSON, LIMITED, West Riding and Silkstone Collieries, near LEEDS.

M. BREMOND'S NAPHTHALINE PROCESS.

All negotiations respecting M. Brémond's patented process for preventing Deposits of

NAPHTHALINE

in Gas Main and Service Pipes should be addressed to Mr. W. H. BENNETT, 22, Great George Street, WESTMINSTER, S.W., or to M. BREMOND, Gas Engineer, Compania Madrilena de Alumbrado y Calefaccion por Gas, MADRID, who may be consulted upon all matters connected with the Gas Industry.



RETORT BOLTS,

AND ALL KINDS OF

BOLTS AND NUTS,

SUITABLE FOR

GAS-WORKS,

SUPPLIED BY

JOHN STANSFELD,

Bolt & Nut Manufacturer,

ALFRED ST., BOAR LANE, LEEDS.

FERRAND DAVIES,

148 GRESHAM HOUSE, OLD BROAD STREET, LONDON, E.C.,

AGENT FOR

THOMAS BARR'S LESMAHAGOW MAIN CANNEL,

AND

NEWTON, CHAMBERS, & CO.'S SILKSTONE GAS COALS.

Analyses and Quotations on application.

WILSON CARTER AND PEARSON,

GAS COAL AND CANNEL FACTORS,

Supply to any Railway Station or for Export all kinds of Fuel for Gas purposes.

Address—CHIEF OFFICES:

TEMPLE BUILDINGS, 50, NEW STREET, BIRMINGHAM.

GEORGE ANDERSON,

GAS AND CONSULTING ENGINEER,

35A, GREAT GEORGE STREET,

WESTMINSTER, S.W.,

PATENTEE and MANUFACTURER of the following Inventions:—

RETORT SETTINGS—giving great Economy of Fuel.

STEAM-ENGINES and EXHAUSTERS, FOUR-WAY VALVES, WASHERS, SCRUBBERS.

FUEL-MACHINE, for Compressing Breeze and Tar.

N.B.—Pamphlet, with Eighteen Illustrations and Letterpress on the Construction of Gas-Works, post free, 2s. 6d.

PRICES AND ALL PARTICULARS TO BE HAD OF THE PATENTEE,

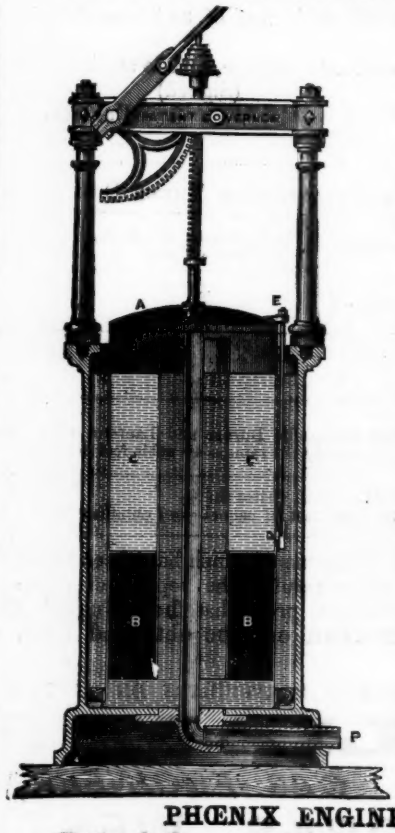
35a, GREAT GEORGE STREET, WESTMINSTER, S.W.

GEORGE WALLER & CO.,

GAS AND HYDRAULIC ENGINEERS,

Patent Compensating Steam Governor,

WITH SELF-CONTAINED WATER-BALANCE.



DESCRIPTION OF THE APPARATUS.

The illustration represents a section of the Patent Governor. The lower part of the Bell A is fitted with a loose Float B, and in the upper part of the Bell is a deep annular Water Chamber C, at the bottom of which is an opening D, with a slide outside regulated by a Screw Spindle E, to allow the water to pass in and out of the Chamber C quickly or slowly, according to circumstances, but when once adjusted the slide does **not require altering.** This Self-compensating Chamber gives great steadiness to the up and down movement of the Bell and effectively prevents the "hunting" motion so common with other Governors, thereby ensuring a more perfect action on the throttle-valve of the Engine **than attained by any other.** The sketch shows the clip lever fixed to work on throttle-valve at an angle, and can work in either direction. P is the Gas Inlet-pipe to Governor.

G. W. & Co. also make **special Steam Throttle Valves,** suitable for working with this Governor, and alter existing Throttle Valves to same plan.

PHŒNIX ENGINEERING WORKS,

Holland Street and Bear Gardens, Southwark, S.E.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

DODWORTH, BARNSLEY.

BENJAMIN WHITWORTH, Esq., M.P. . . . . Chairman.
Mr. RICHARD HARTLEY . . . . . Managing Director.

REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—
"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of **16·66** candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

SULPHATE AMMONIA.

R. W. WALLACE & CO.,

60, MARK LANE, LONDON, E.C.,

Are Buyers of SULPHATE AMMONIA in Large or Small Quantities, or Sell on Commission for Gas Companies and Makers.

PLANT ERECTED ON THE LATEST AND MOST APPROVED PRINCIPLE.

AGENTS to THE GASLIGHT AND COKE COMPANY, LONDON, for the SALE of SULPHATE AMMONIA. Works: BECKTON.

PARIS EXHIBITION,
1878.

THREE MEDALS
AND
HONOURABLE MENTION
HAVE BEEN AWARDED TO
JOSEPH CLIFF & SONS
For their Various Exhibits, amongst which is a
SILVER MEDAL
FOR THEIR
PATENT MACHINE-MADE
RETORTS AND FIRE-BRICKS,
Being the Highest Honour given for this class.

Established

1795.

JOSEPH CLIFF & SONS,

THE ORIGINAL
WORTLEY FIRE-BRICK WORKS,
NEAR LEEDS,

London Wharf: No. 4, inside Great Northern Goods Station, King's Cross, N. Liverpool: Leeds Street.

SPECIAL NOTICE.—Our Patent Machine-Made Retorts have now been thoroughly tested, and have proved themselves infinitely superior to those made by hand. At several large works it has been settled, beyond question, that, owing to the compactness and general excellence, more gas is sent to the gasholder from each ton of coal carbonized than is the case with hand-made Retorts.

NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS AND COLLIERIES,
NEAR SHEFFIELD.

CELEBRATED SILKSTONE GAS COALS.

The various descriptions of Gas Coal produced from the above Collieries possess an unequalled reputation, combining in a large degree the constituents essential for the production of the best quality of Coke and Gas of a high illuminating power.

A recent extensive development of the Collieries enables us to offer increased supplies.

JAS. PATERSON, Esq., of Warrington, after testing various qualities of our Coal, has sent the following testimony of their merits:—

"*Warrington Gaslight and Coke Company,*
Offices, Mersey Street, Warrington, April 23, 1877.

"MESSRS. NEWTON, CHAMBERS, AND CO.,

"GENTLEMEN,—After carefully testing the various samples of Gas Coals sent from your Collieries for analysis, I have pleasure in reporting them as belonging to the highest class of Gas and Coking Coals.

"The average of Nine samples gives a yield of **12,500** cubic feet of **15½**-Candle Gas, being equivalent to **664** lbs. of sperm per ton, and **1420** lbs. of fixed carbon of a very superior quality. All the samples bear a close relation to each other in value.

"Yours truly, "JAMES PATERSON."

Full particulars will be sent on application to us—address as above.

THE

UNVARYING WATER-LINE GAS-METER.

(SANDERS AND DONOVAN'S PATENT.)

"Unquestionably the best Water Gas-Meter now in use."—THOS. G. BARLOW, C.E.

Over 120,000 in action.

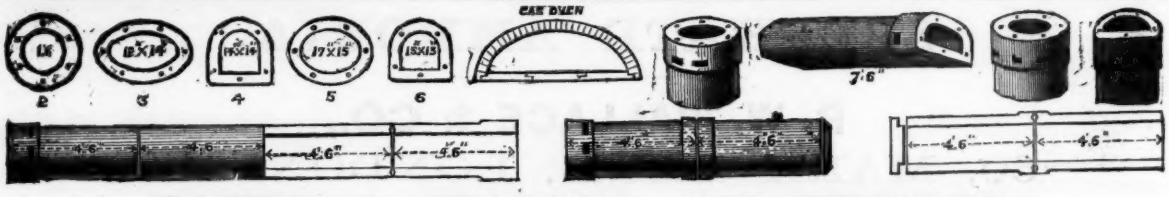
MANUFACTURERS:

THE GAS-METER COMPANY, LIMITED,

KINGSLAND ROAD, LONDON;

WITH

Branch Manufactories at DUBLIN and OLDHAM.



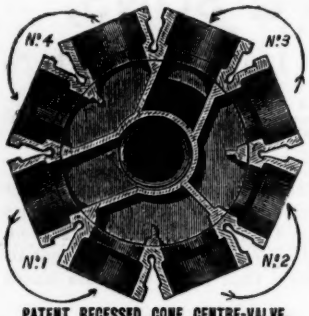
HARRIS & PEARSON, STOURBRIDGE,

Proprietors of Best Clay Mines. Largest makers in the World of Gas-Retorts, Lumps, Tiles, Fire-Bricks, and Fire-Clay Goods of all kinds. 200,000 feet of Gas-Retorts of all Sizes and Patterns in Stock, all in good order. Orders for any Size executed on receipt.

CAST-IRON GAS AND WATER PIPES,

WROUGHT IRON AND LEAD TUBING, GLAZED DRAIN-PIPES,

STAFFORDSHIRE BLUE BRICKS.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Plan.

R. LAIDLAW AND SON,

EDINBURGH AND GLASGOW,

SOLE MAKERS OF

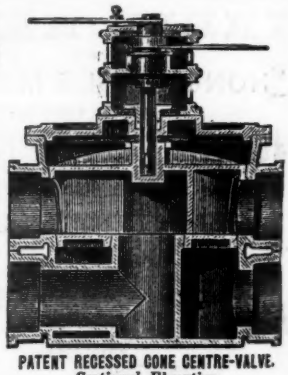
PATENT

RECESSED CONE CENTRE-VALVES,

Constructed on the principle of the ordinary Plug-Cock.

THROUGH-WAY & FOUR-WAY COCKS

Of all descriptions.



PATENT RECESSED CONE CENTRE-VALVE.
Sectional Elevation.

London Office: 6, LITTLE BUSH LANE, CANNON STREET.

D. HULETT & CO.

Invite the attention of Gas Companies, Corporations, and others to their

PATENT STREET LAMPS,

Which are so constructed that neither putty nor other materials are required to secure the glass. No hacking out of old putty, which frequently destroys the frames. A new pane of glass can be inserted in two or three minutes by any inexperienced person, the glass being secured by a hinged flap and turn button.

PRICE, with Opaline Reflecting Top, 12s.; with Fluted Glass Top, 10s. 6d.
Also made EXTRA STOUT recommended for its durability.

D. HULETT'S IMPROVED SERVICE CLEANSER,

By the use of which stoppages in service and other pipes are freed from naphthaline and other obstructions in a few minutes. PRICE 73s. net.

HULETT'S PATENT MERCURIAL REGULATOR,

For inserting in mains, to prevent the excess of pressure in high ground, or other elevated positions.

PATENTEES OF IMPROVED WET AND DRY GAS-METERS.

Makers of all kinds of Pressure-Gauges, Gaseliers, and every kind of Gas-Fittings for the Trade.

GAS HEATING AND COOKING STOVES.

55 and 56, HIGH HOLBORN, LONDON.

London: Printed by WALTER KING, for the Executors of the late WILLIAM BOUGHTON KING (at the office of Clayton and Co., 17, Bouverie Street, Fleet Street), and published by him at No. 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, July 15, 1879.